User Manual

ControlNet PLC-5 Programmable Controllers

Cat. No. 1785-L20C, -L40C

product icon

Important User Information

Because of the variety of uses for the products described in this publication, those responsible for the application and use of this control equipment must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes, and standards.

The illustrations, charts, sample programs and layout examples shown in this guide are intended solely for purposes of example. Since there are many variables and requirements associated with any particular installation, Allen-Bradley does not assume responsibility or liability (to include intellectual property liability) for actual use based on the examples shown in this publication.

Allen-Bradley publication SGI-1.1, Safety Guidelines for the Application, Installation, and Maintenance of Solid-State Control (available from your local Allen-Bradley office), describes some important differences between solid-state equipment and electromechanical devices that should be taken into consideration when applying products such as those described in this publication.

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Throughout this manual, we use notes to make you aware of safety considerations:

ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage or economic loss.

Attention statements help you to:

- identify a hazard
- avoid the hazard
- recognize the consequences

Important: Identifies information that is critical for successful application and understanding of the product.

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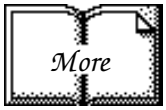
Using This Manual

Introduction

This manual describes how to install your processor as well as how to plan for, configure, and use the features of a PLC-5/20C™ or PLC-5/40C™ programmable controller that are unique to the ControlNet™ network.



For detailed information on features that the PLC-5/20C or PLC-5/40C programmable controllers share with the PLC-5/20™ and -5/40™ processors, see the Enhanced and Ethernet PLC-5 Programmable Controllers User Manual, publication 1785-6.5.12.

Audience

The information in this manual is intended for engineers and technicians who are installing, programming, and maintaining a control system that includes a PLC-5/20C or PLC-5/40C programmable controller.

You should have a background in control-system applications and a basic knowledge of:

- programmable real-time control systems
- the PLC-5® control system
- your operation's required systems and applications

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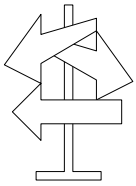

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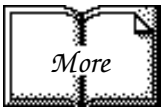
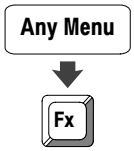
Terminology

Term	Description
ControlNet network	communication architecture that allows the exchange of data between Allen-Bradley Company, Inc. products and certified third-party products
connection	opened communication path between two nodes on a ControlNet network
discrete I/O data transfer	type of data transfer in which single units of I/O have discrete relationships with values in the processor's data table; uses the processor's input- and output-image tables (I and O files); configured on a per-node basis in the ControlNet I/O map table
frame	single data transfer on a ControlNet link
drop cable	cable that connects a ControlNet node to the trunk cable; integral part of 1786 taps
I/O map table	table that you configure using the programming software to map data from an I/O chassis and other devices on the ControlNet network to particular data-table file addresses
link	collection of ControlNet nodes with unique network addresses in the range of 01-107; segments connected by repeaters make up a link; links connected by bridges make up a network
map-table entry	one entry in the I/O map table that you configure using the programming software to map data from one I/O chassis or other device on ControlNet to particular data-table file addresses
maximum scheduled node	node with the highest network address that can use scheduled time on a ControlNet link
maximum unscheduled node	node with the highest network address that can use unscheduled time on a ControlNet link
network access port (NAP)	port that provides a temporary ControlNet-network connection through an RJ-45 connector
network address	node's address on the ControlNet network
network update interval (NUI)	single occurrence of the ControlNet Network Update Time (NUT)
network update time (NUT)	repetitive time interval in which data can be sent on the ControlNet network
node	port of a physical device connecting to the ControlNet network that requires a network address in order to function on the network; a link may contain a maximum of 107 nodes
non-discrete I/O data transfer	type of data transfer in which blocks of data transferred to or from I/O modules use integer input and output data-table files that you specify; cannot use the processor's input- and output-image tables (I and O files); scheduled transfers are configured in the ControlNet I/O map table, unscheduled transfers make use of ControlNet I/O Transfer (CIO) instructions
owner	device that controls the outputs of an adapter
redundant media	dual-cable system that allows you to receive the best signal over a ControlNet network
repeater	two-port active physical-layer device that reconstructs and retransmits all traffic that it hears on one ControlNet segment to another segment
scheduled transfers	deterministic and repeatable transfers that are continuous and asynchronous to the ladder- logic program scan
segment	trunkline section of ControlNet network with terminators at each end; a segment does not include repeaters; segments connected by repeaters make up a link
tap	component that connects products to the ControlNet trunk cable; a tap is required for each node and for each side of a repeater
terminator	75Ω resistor—mounted in a BNC plug—placed on each end of a ControlNet segment to prevent reflections from occurring at the ends of the cable
trunk cable	bus or central part of the ControlNet cable system
trunk-cable section	length of trunk cable between any two ControlNet taps
unscheduled transfers	non-deterministic data transfers through ladder-initiated communication or programming devices

Conventions

This icon 

indicates that the current topic is discussed further in the publication(s) referenced

A series like this 

indicates a keystroke procedure for you to follow to get to the correct screen or to complete a task using software

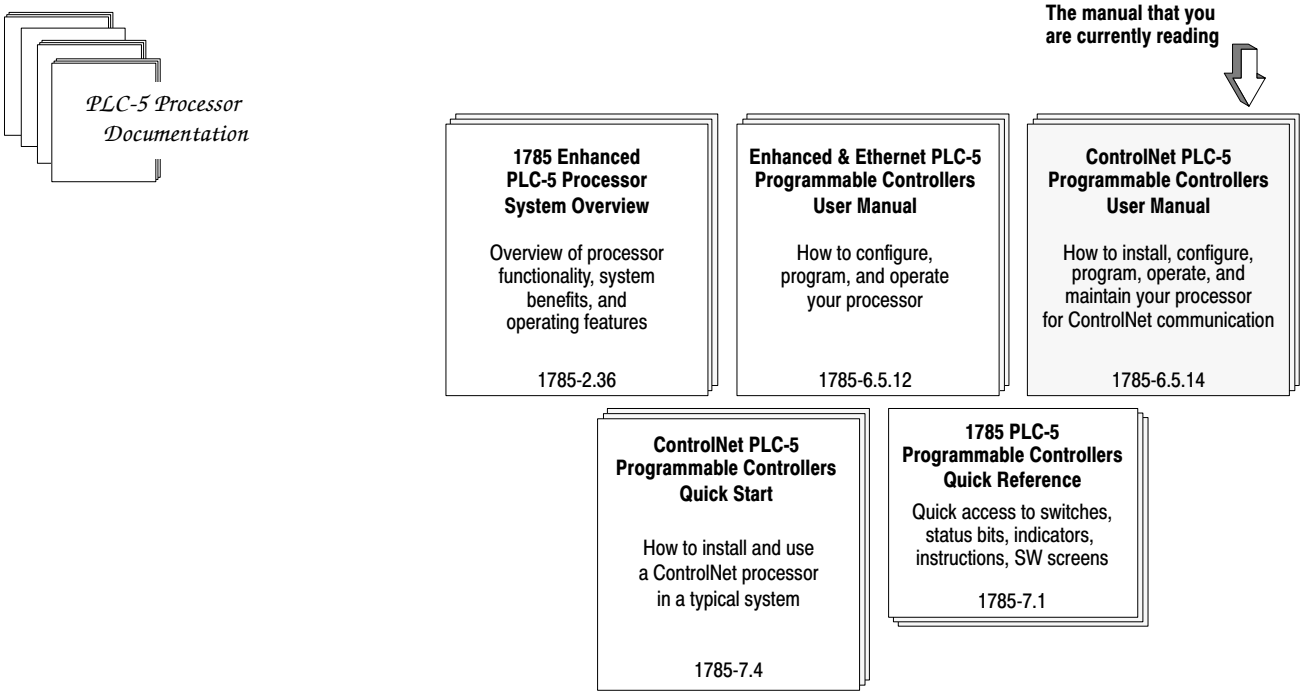
Text that shows what a terminal displays is shown like this: **`Press a key`**

Text in square brackets indicates an actual key that you press—i.e., **`[F1]`**

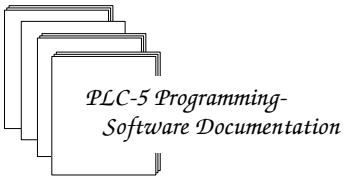
Text describing information that you must provide is italicized—i.e., *`filename`*

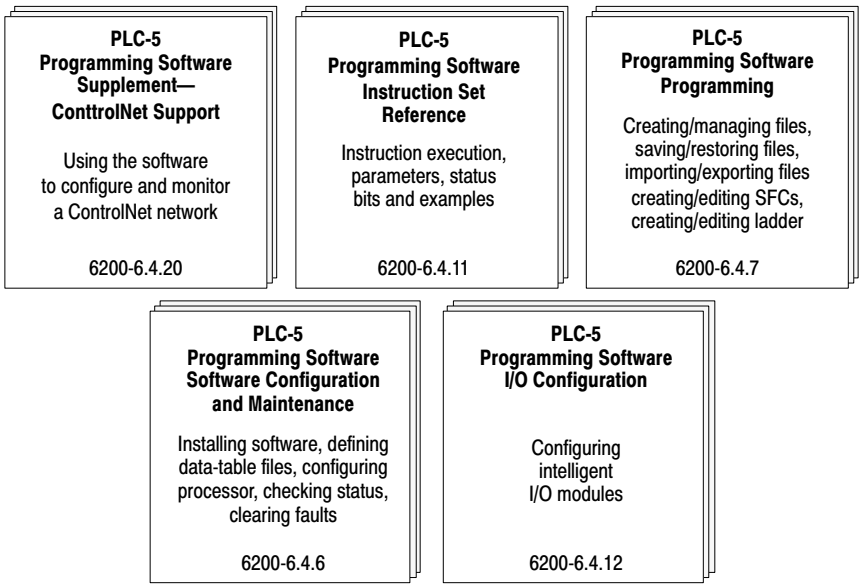
Related Publications

The 1785 PLC-5 programmable-controller, 6200 programming-software, and ControlNet documentation is organized into manuals according to the tasks that you perform.

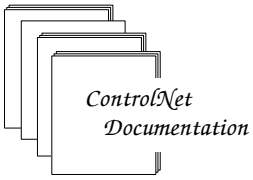

PLC-5 Processor Documentation
The manual that you are currently reading
1785 Enhanced PLC-5 Processor System Overview
Overview of processor functionality, system benefits, and operating features
1785-2.36
Enhanced & Ethernet PLC-5 Programmable Controllers User Manual
How to configure, program, and operate your processor
1785-6.5.12
ControlNet PLC-5 Programmable Controllers User Manual
How to install, configure, program, operate, and maintain your processor for ControlNet communication
1785-6.5.14
ControlNet PLC-5 Programmable Controllers Quick Start
How to install and use a ControlNet processor in a typical system
1785-7.4
1785 PLC-5 Programmable Controllers Quick Reference
Quick access to switches, status bits, indicators, instructions, SW screens
1785-7.1

For more information on 1785 PLC-5 programmable controllers or the above publications, contact your local Allen-Bradley Company, Inc. sales office or distributor.





For more information on PLC-5 programming software or the above publications, contact your local Allen-Bradley Company, Inc. sales office or distributor.



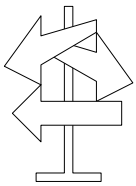
For detailed information on different aspects of planning and installing your ControlNet network, see the following publications:

Publication	Publication Number
ControlNet Cable System Component List	AG-2.2
ControlNet Cable System Planning and Installation Manual	1786-6.2.1
ControlNet Coax Tap Installation Instructions	1786-2.3
ControlNet Network Access Cable Installation Instructions	1786-2.6
ControlNet Repeater Installation Instructions	1786-2.7
Industrial Automation Wiring and Grounding Guidelines	1770-4.1

Chapter 1

Installing Your ControlNet PLC-5 Processor

Using This Chapter



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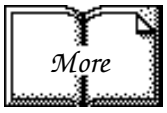


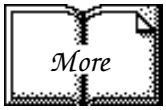
For detailed information on installing chassis and adapters, see the Enhanced and Ethernet PLC-5 Programmable Controllers User Manual, publication 1785-6.5.12.

Before You Begin

Before installing your ControlNet PLC-5 processor:

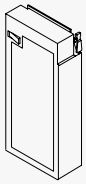
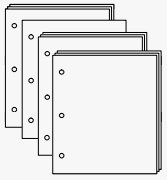
1. Complete the following:

- determine the proper environment
- configure the proper grounding
- route the conductors properly



For detailed information on completing these tasks, see the Enhanced and Ethernet PLC-5 Programmable Controllers User Manual, publication 1785-6.5.12.

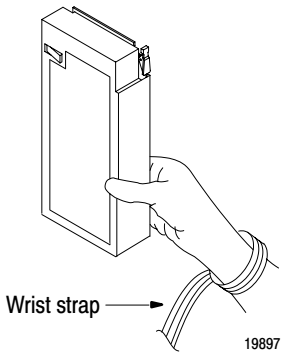
2. Check your processor package, and make sure that you have the following:

Processor 	ControlNet PLC-5® Programmable Controller, 1785-L20C or -L40C	
Contents of Tray	1	Lithium Battery, 1770-XYC
	1	DIN connector cover
	4	Terminating resistors—150Ω①
	2 or 4②	Terminating resistors—82Ω③
	2 or 4②	3-pin connectors
	2	Keys
	1	Battery cover with screw
	1	1784-CP7 cable adapter for 1784-CP, -CP5 cables
Documentation 	ControlNet PLC-5 Programmable Controllers User Manual, publication 1785-6.5.14	
	ControlNet PLC-5 Programmable Controllers Release Notes, publication 1785-6.5.14-RN1	
	CSA Hazardous Location Approval Supplemental Information, publication AG-4.1	
	Enhanced and Ethernet PLC-5 Programmable Controllers User Manual, publication 1785-6.5.12	
	Guidelines for Handling Lithium Batteries, publication AG-5.4	
	Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	

① Identified by four colored bands: brown, green, brown, and gold
② Two with a PLC-5/20C processor, four with a PLC-5/40C processor
③ Identified by four colored bands: gray, red, black, and gold

If any items are missing or incorrect, contact your local Allen-Bradley Company, Inc. sales office or distributor.

Handling the Processor



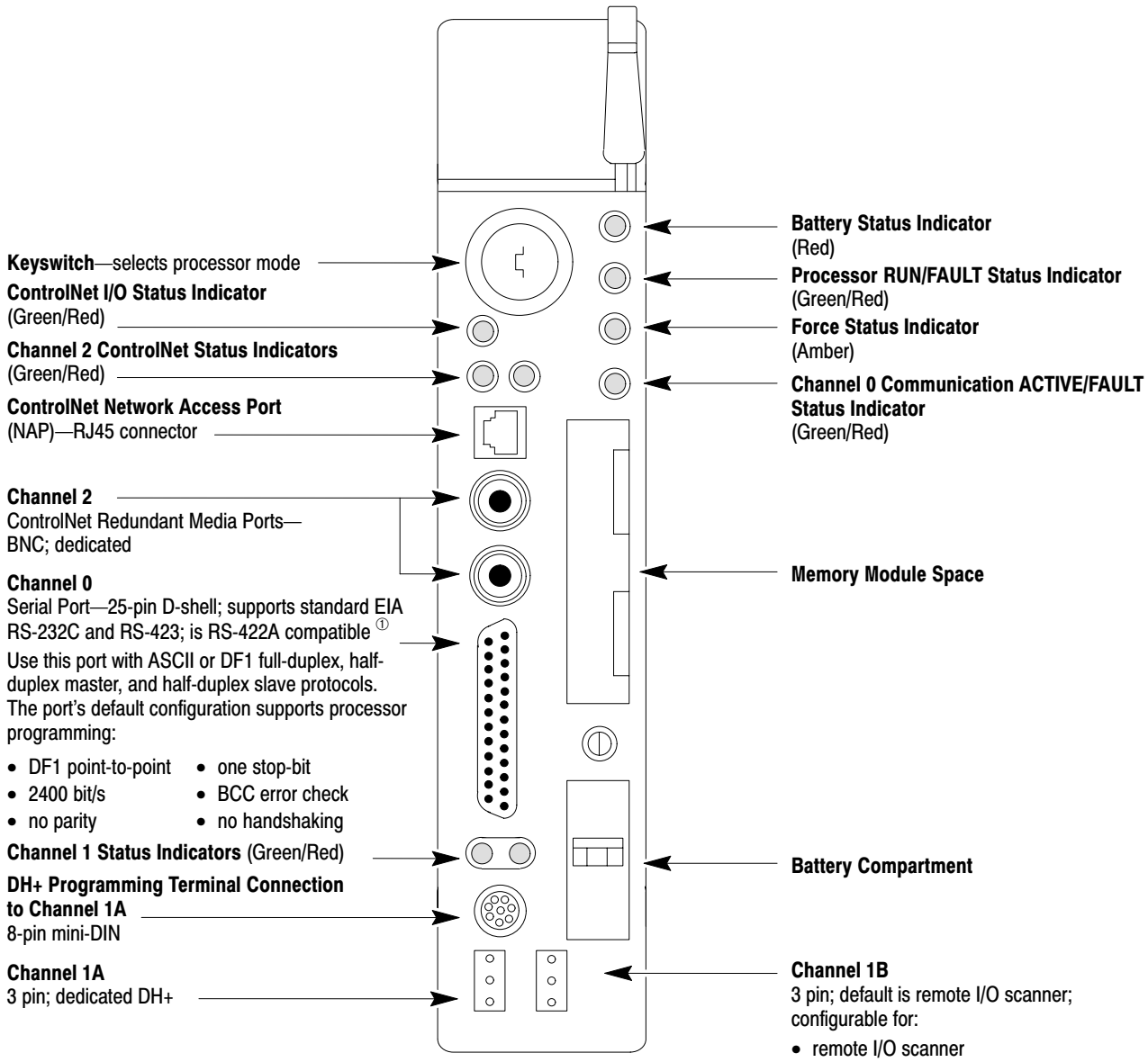
Your processor is shipped in a static-shielded container to guard against electrostatic damage. Electrostatic discharge can damage integrated circuits or semiconductors in the processor if you touch backplane connector pins. It can also damage the module when you set configuration plugs or switches inside the module. Avoid electrostatic damage by observing the following precautions.

- Remain in contact with an approved ground point while handling the module—wear a properly grounded wrist strap.
- Do not touch the backplane connector or connector pins.
- When not in use, keep the module in its static-shielded container.

Identifying ControlNet PLC-5 Processor Components

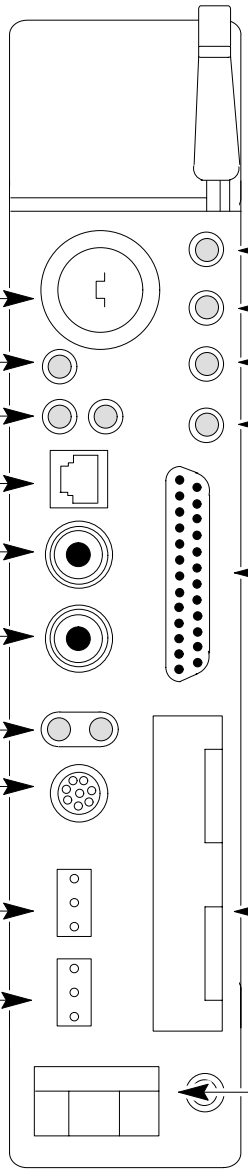
Figure 1.1 and Figure 1.2 show the front panels of the ControlNet PLC-5 processors.

Figure 1.1
PLC-5/20C Processor Front Panel


Keyswitch—selects processor mode
ControlNet I/O Status Indicator (Green/Red)
Channel 2 ControlNet Status Indicators (Green/Red)
ControlNet Network Access Port (NAP)—RJ45 connector
Channel 2 ControlNet Redundant Media Ports—BNC; dedicated
Channel 0 Serial Port—25-pin D-shell; supports standard EIA RS-232C and RS-423; is RS-422A compatible ①
Use this port with ASCII or DF1 full-duplex, half-duplex master, and half-duplex slave protocols. The port's default configuration supports processor programming:
• DF1 point-to-point
• 2400 bit/s
• no parity
• one stop-bit
• BCC error check
• no handshaking
Channel 1 Status Indicators (Green/Red)
DH+ Programming Terminal Connection to Channel 1A 8-pin mini-DIN
Channel 1A 3 pin; dedicated DH+
Battery Status Indicator (Red)
Processor RUN/FAULT Status Indicator (Green/Red)
Force Status Indicator (Amber)
Channel 0 Communication ACTIVE/FAULT Status Indicator (Green/Red)
Memory Module Space
Battery Compartment
Channel 1B 3 pin; default is remote I/O scanner; configurable for:
• remote I/O scanner
• remote I/O adapter
• DH+ communication
• unused

① Channel 0 is optically coupled (provides high electrical noise immunity) and can be used with most RS-422A equipment as long as:
- termination resistors are not used
- the distance and transmission rate are reduced to comply with RS-423 requirements

Figure 1.2
PLC-5/40C Processor Front Panel



Keyswitch—selects processor mode

ControlNet I/O Status Indicator
(Green/Red)

Channel 2 ControlNet Status Indicators
(Green/Red)

ControlNet Network Access Port
(NAP)—RJ45 connector

Channel 2
ControlNet Redundant Media Ports—
BNC; dedicated

Channel 1 Status Indicators (Green/Red)

DH+ Programming Terminal Connection to Channel 1A
8-pin mini-DIN, parallel with 3-pin connectors of Channel 1A; use only when Channel 1A is configured for DH+ communications

Channel 1A
3 pin; default is DH+; configurable for:

- remote I/O scanner
- remote I/O adapter
- DH+ communication
- unused

Channel 1B
3 pin; default is remote I/O scanner; configurable for:

- remote I/O scanner
- remote I/O adapter
- DH+ communication
- unused

Battery Status Indicator
(Red)

Processor RUN/FAULT Status Indicator
(Green/Red)

Force Status Indicator
(Amber)

Channel 0 Communication ACTIVE/FAULT Status Indicator
(Green/Red)

Channel 0
Serial Port—25-pin D-shell; supports standard EIA RS-232C and RS-423; is RS-422A compatible ①

Use this port with ASCII or DF1 full-duplex, half-duplex master, and half-duplex slave protocols. The port's default configuration supports processor programming:

- DF1 point-to-point
- 2400 bps
- no parity
- one stop-bit
- BCC error check
- no handshaking

Memory Module Space

Battery Compartment

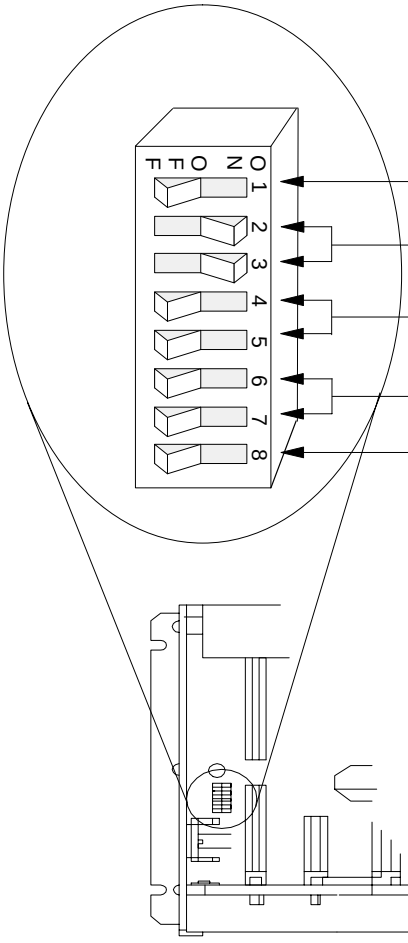
① Channel 0 is optically coupled (provides high electrical noise immunity) and can be used with most RS-422A equipment as long as:

- termination resistors are not used
- the distance and transmission rate are reduced to comply with RS-423 requirements

Setting the I/O Chassis Backplane Switches

Set the I/O chassis backplane switches using a ball-point pen to set each switch.

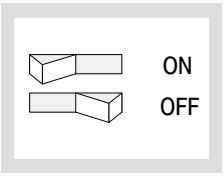
Important: Do not use a pencil because the tip can break off and short the switch.



Switch	Last State
1	
ON	Outputs of this I/O chassis remain in their last state when a hardware failure occurs.①
OFF	Outputs of this I/O chassis are turned off when a hardware failure occurs.①

Always OFF

Switches		Addressing
4	5	
OFF	OFF	2 – slot
OFF	ON	1 – slot
ON	OFF	1/2 – slot
ON	ON	Not allowed



Switches		EEPROM Transfer
6	7	
OFF	OFF	EEPROM memory transfer to processor memory at powerup.②③
ON	ON	EEPROM memory transfers to processor memory if processor memory not valid.
ON	OFF	EEPROM memory does not transfer to processor memory.④

Switch	Processor Memory Protection
8	
OFF	Processor memory protection disabled.
ON	Processor memory protection enabled.⑤

① Regardless of this switch setting, outputs are turned off when any of the following occurs:
- processor detects a runtime error
- an I/O chassis backplane fault occurs
- you select Program or Test mode
- you set a status file bit to reset a local rack

② If an EEPROM module is not installed and processor memory is valid, the processor's PROC indicator blinks and the processor sets S:11/9, bit 9 in the major fault status word. To clear this fault, change the processor from Program mode to Run mode and back to Program mode.

③ If the processor's keyswitch is set in Remote, the processor enters Remote Run mode after it powers up and has its memory updated by the EEPROM module.

④ A processor fault (solid red PROC LED) occurs if processor memory is not valid.

⑤ You cannot clear processor memory when this switch is on.

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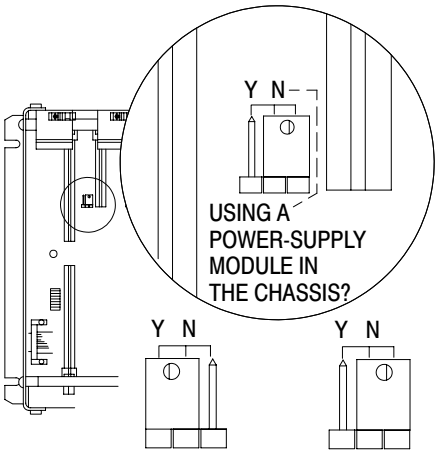
Setting the I/O Chassis Configuration Plug

Set the I/O chassis configuration plug as follows:


Y N
USING A POWER-SUPPLY MODULE IN THE CHASSIS?
Y N
Y N
Set Y when you install a power-supply module in the chassis.
Set N when you use an external power supply.

1. Locate the chassis configuration plug (between the two left most slots of the chassis).
2. Set the I/O chassis configuration plug.

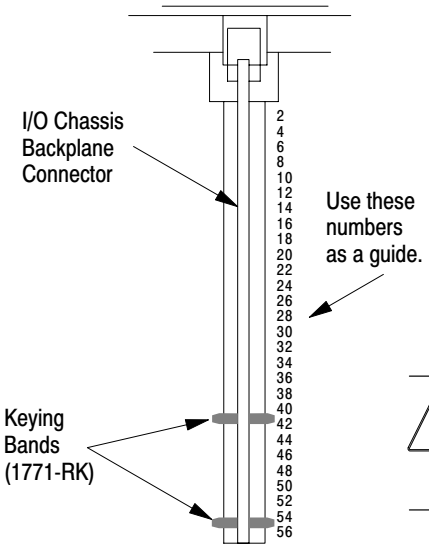
   The default setting is N (not using a power-supply module in the chassis).

Important: You cannot power a single I/O chassis with both a power-supply module and an external power supply.

17075

Installing Keying Bands for the Processor

You receive plastic keying bands with each I/O chassis. Insert the keying bands as follows:



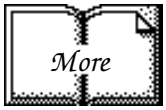
Install a keying band in the left-most slot between the following pins:

- 40 and 42
- 54 and 56

ATTENTION: A module inserted into a wrong slot could be damaged by improper voltages connected through the wiring arm. Use keying bands to prevent damage to the module.

12062

Installing and Disposing of the Processor Battery



The 1770-XYC battery ships with the processor and requires special handling.

For more detailed information on installing and disposing of the battery, see the Allen-Bradley Guidelines for Lithium Battery Handling and Disposal, publication AG-5.4.

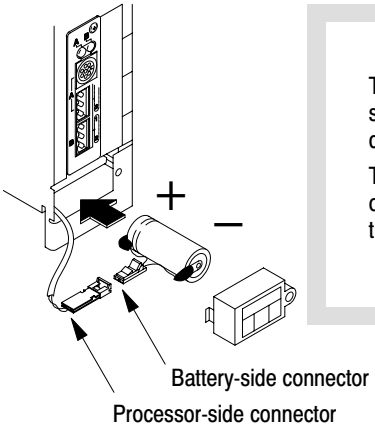
ATTENTION: To maintain CSA certification for hazardous areas, do not substitute any other battery for the 1770-XYC.

Installing or Removing the Processor Battery

Tip You can insert or remove the battery without powering down the processor. If you do not want to lose your program, make sure that the processor is powered on when removing the battery.

To install or remove the battery, follow these steps:

1. Remove the thumb screw on the processor's battery cover, remove the cover, and locate the battery.
2. Install or remove the battery:



To **install** the battery, slide the battery-side connector into the processor-side connector until you hear them snap.

To **remove** the battery, press the lever on the battery-side connector and slide the connectors apart.

19331

3. Replace the battery cover, and secure the battery cover with the thumb screw.
4. On the battery cover, write the date that you installed the last new battery.

Replacing the Battery

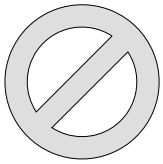
Tip You can insert or remove the battery without powering down the processor. If you do not want to lose your program, make sure that the processor is powered when replacing the battery.

Replace the lithium battery every year or when the BATT status indicator is red. For estimated battery lifetimes, see the table below:

Processor	Temperature	Worst-Case Battery-Life Estimates Power Off 100%	Power Off 50%	Battery Duration①
PLC-5/20C	60°C	218 days	1.17 years	3.7 days
	25°C	1.7 years	3.34 years	15 days
PLC-5/40C	60°C	105 days	207 days	40 hours
	25°C	1.3 years	2.57 years	10.8 days

① The battery status indicator (BATT) warns you when the battery is low. These durations are based on the battery supplying the only power to the processor—power to the chassis is off—once the status indicator first lights.

Disposing of the Battery



Do not dispose of lithium batteries in a general trash collection when their combined weight is greater than or equal to 0.5 gram. A single 1770-XYC battery contains 0.65 grams of lithium. Check your state and local regulations that deal with the disposal of lithium batteries.

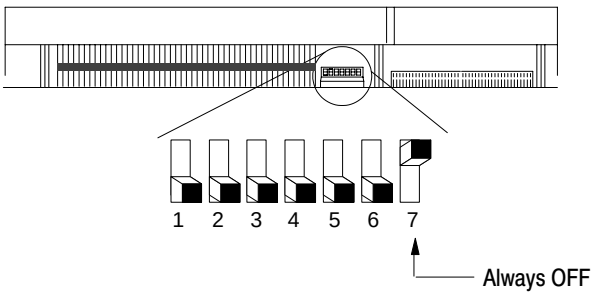
ATTENTION: Follow these precautions:

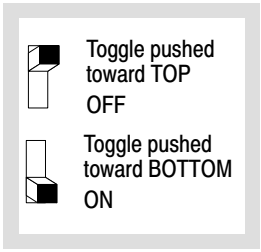
- **Do not** incinerate or expose the battery to high temperatures.
- **Do not** solder the battery or leads; the battery could explode.
- **Do not** open, puncture, or crush the battery. The battery could explode or toxic, corrosive, and flammable chemicals could be exposed.
- **Do not** charge the battery. An explosion may result, or the cell may overheat and cause burns.
- **Do not** short positive and negative terminals together. The battery will heat up.

Selecting the DH+ Station Address of Channel 1A

To select the DH+ station address of Channel 1A, set the switches of assembly SW1.

Side View of PLC-5/40C Processor
Switch Assembly SW1





To select:	Set switch:	To:
DH+ Station Number	1 through 6	(See below)

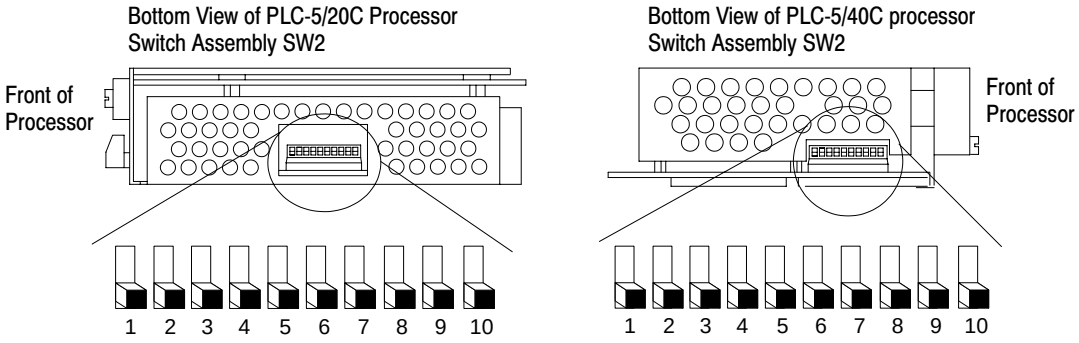
Switch 7 is not used—set it to OFF

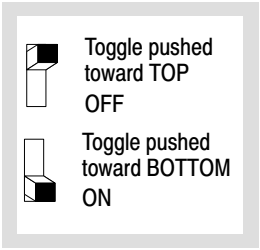
DH+ Station Number	Switch					
	1	2	3	4	5	6
0	on	on	on	on	on	on
1	off	on	on	on	on	on
2	on	off	on	on	on	on
3	off	off	on	on	on	on
4	on	on	off	on	on	on
5	off	on	off	on	on	on
6	on	off	off	on	on	on
7	off	off	off	on	on	on
10	on	on	on	off	on	on
11	off	on	on	off	on	on
12	on	off	on	off	on	on
13	off	off	on	off	on	on
14	on	on	off	off	on	on
15	off	on	off	off	on	on
16	on	off	off	off	on	on
17	off	off	off	off	on	on
20	on	on	on	on	off	on
21	off	on	on	on	off	on
22	on	off	on	on	off	on
23	off	off	on	on	off	on
24	on	on	off	on	off	on
25	off	on	off	on	off	on
26	on	off	off	on	off	on
27	off	off	off	on	off	on
30	on	on	on	off	off	on
31	off	on	on	off	off	on
32	on	off	on	off	off	on
33	off	off	on	off	off	on
34	on	on	off	off	off	on
35	off	on	off	off	off	on
36	on	off	off	off	off	on
37	off	off	off	off	off	on

DH+ Station Number	Switch					
	1	2	3	4	5	6
40	on	on	on	on	on	off
41	off	on	on	on	on	off
42	on	off	on	on	on	off
43	off	off	on	on	on	off
44	on	on	off	on	on	off
45	off	on	off	on	on	off
46	on	off	off	on	on	off
47	off	off	off	on	on	off
50	on	on	on	off	on	off
51	off	on	on	off	on	off
52	on	off	on	off	on	off
53	off	off	on	off	on	off
54	on	on	off	off	on	off
55	off	on	off	off	on	off
56	on	off	off	off	on	off
57	off	off	off	off	on	off
60	on	on	on	on	off	off
61	off	on	on	on	off	off
62	on	off	on	on	off	off
63	off	off	on	on	off	off
64	on	on	off	on	off	off
65	off	on	off	on	off	off
66	on	off	off	on	off	off
67	off	off	off	on	off	off
70	on	on	on	off	off	off
71	off	on	on	off	off	off
72	on	off	on	off	off	off
73	off	off	on	off	off	off
74	on	on	off	off	off	off
75	off	on	off	off	off	off
76	on	off	off	off	off	off
77	off	off	off	off	off	off

Specifying the Serial Interface of Channel 0

Specify RS-232C, RS-422A, or RS-423 communication for Channel 0 by setting the switches of assembly SW2.

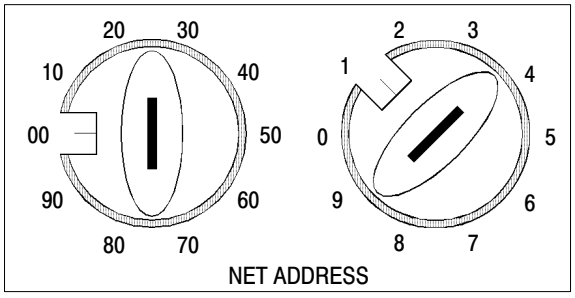

Bottom View of PLC-5/20C Processor
Switch Assembly SW2
Front of Processor
1 2 3 4 5 6 7 8 9 10
Bottom View of PLC-5/40C processor
Switch Assembly SW2
Front of Processor
1 2 3 4 5 6 7 8 9 10



To Specify:	Set Switches:									
	1	2	3	4	5	6	7	8	9	10
RS-232C	ON	ON	ON	OFF	OFF	ON	ON	OFF	ON	OFF
RS-422A	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF	ON	OFF
RS-423	ON	ON	ON	OFF	OFF	ON	OFF	OFF	ON	OFF

Selecting the ControlNet Network Address of Channel 2

Select your processor's ControlNet network address by setting the two 10-digit rotary switches on the top of the processor.



Network address 01 is shown

Tip

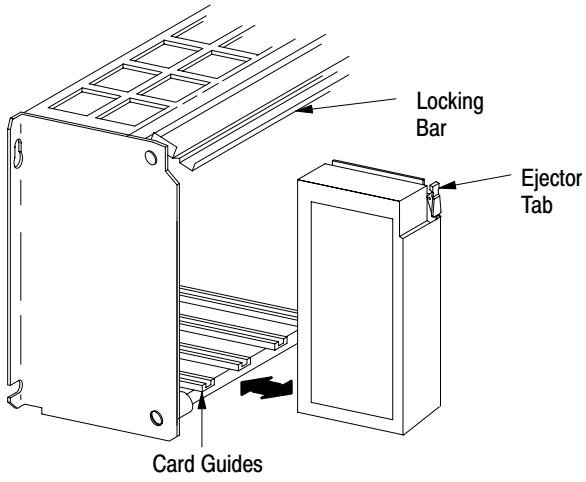
For optimum throughput, assign addresses to your ControlNet nodes in a sequential order starting with 01 for the controlling processor.

You can select from as many as 99 network addresses (from 01 to 99) for a processor on a ControlNet link. 00 is invalid.

Inserting/Removing the Processor into/from the I/O Chassis

To insert/remove the processor into/from the chassis, do the following:

ATTENTION: Make certain that power to the chassis is off before inserting or removing the processor.



To **insert** a processor into the chassis:

1. Lift the locking bar and the ejector tab.
2. Slide the processor into the left-most slot of the I/O chassis.
3. Press down on the ejector tab, and then close the locking bar over the processor.

To **remove** a processor from the chassis:

1. Save processor memory.
2. Remove power to the processor-resident chassis.
3. Disconnect all cables from the processor's ports.
4. Lift the locking bar and the ejector tab, and then slide the processor from the chassis.

19898

Installing a Remote I/O Link

Install a remote I/O link using 1770-CD cable and either a daisy-chain or trunk-cable/drop-cable configuration.

Verify that your system's design plans specify cable lengths within allowable measurements.

Important: The maximum cable length for remote I/O depends on the transmission rate. Configure all devices on a remote I/O link to communicate at the same rate.

Trunk-cable/drop-cable considerations:

When using a trunk-cable/drop-cable configuration, use 1770-SC station connectors and follow these cable-length guidelines:

- trunk-cable length—depends on the communication rate of the link; see Table 1.A
- drop-cable length—30.4 m (100 cable-ft) maximum

Important: When using a trunk-cable/drop-cable configuration, set your communication rate to 57.6kK bit/s.

More

For more information about designing trunk-cable/drop-cable configurations, see the Data Highway/Data Highway Plus/Data Highway II/Data Highway 485 Cable Installation Manual, publication 1770-6.2.2.

Table 1.A
Correct Cable Length Based on Communication Rate

A remote I/O link using this communication rate:	Cannot exceed this cable length:
57.6K bit/s	3,048 m (approximately 10,000 ft)
115.2K bit/s	1,524 m (approximately 5,000 ft)
230.4K bit/s	762 m (approximately 2,500 ft)

For proper operation, terminate **both** ends of a remote I/O link by using the external resistors shipped with the programmable controller. Use either a 150Ω or 82Ω terminator.

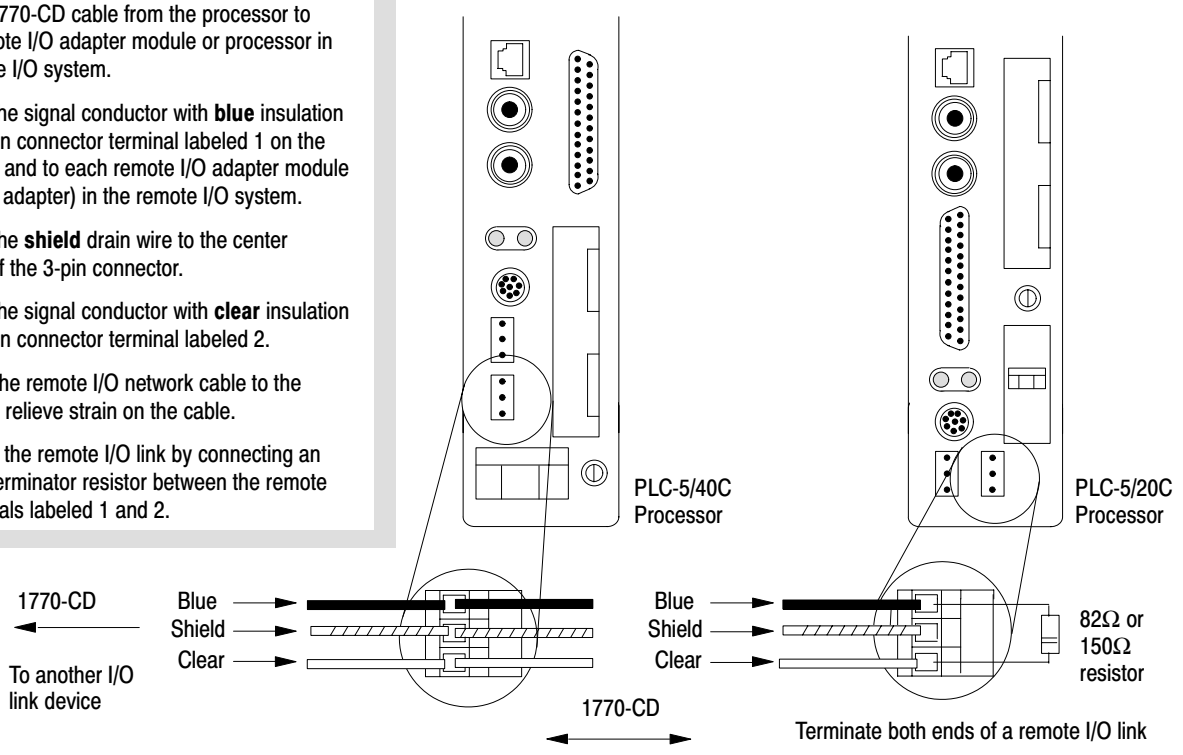
If your remote I/O link:	Use this resistor rating:	The maximum number of *physical* devices that you can connect on the link is:	The maximum number of logical rack numbers that you can scan on the link is:
Operates at 230.4K bit/s	82Ω	32	16
Operates at 57.6K or 115.2K bit/s, and **no** devices listed below are linked Scanners: 1771-SN; 1772-SD, -SD2; 1775-SR, -S4A, -S4B; 6008-SQH1, -SQH2 Adapters: 1771-AS; 1771-ASB (Series A Only); 1771-DCM Miscellaneous: 1771-AF			
Connects to any device listed below: Scanners: 1771-SN; 1772-SD, -SD2; 1775-SR, -S4A, -S4B; 6008-SQH1, -SQH2 Adapters: 1771-AS; 1771-ASB (Series A Only); 1771-DCM Miscellaneous: 1771-AF	150Ω	16	16
Operates at 57.6K or 115.2K bit/s, and you do not require over 16 physical devices			

You can install a remote I/O link two ways:

- trunk cable / drop cable—from the drop cable to the connector screw terminals on the remote I/O connectors of the processor
- daisy chain—to the connector screw terminals on the remote I/O connectors of the processor and then to the remote I/O screw terminals of the next remote I/O device

To connect remote I/O cable:

1. Run the 1770-CD cable from the processor to each remote I/O adapter module or processor in the remote I/O system.
2. Connect the signal conductor with **blue** insulation to the 3-pin connector terminal labeled 1 on the processor and to each remote I/O adapter module (or PLC-5 adapter) in the remote I/O system.
3. Connect the **shield** drain wire to the center terminal of the 3-pin connector.
4. Connect the signal conductor with **clear** insulation to the 3-pin connector terminal labeled 2.
5. Tie wrap the remote I/O network cable to the chassis to relieve strain on the cable.
6. Terminate the remote I/O link by connecting an external terminator resistor between the remote I/O terminals labeled 1 and 2.



Installing a DH+ Link

Use 1770-CD cable to connect the processor to a DH+ link.

Follow these guidelines while installing DH+ communication links:

- do not exceed these cable lengths:
  - trunk-cable length—3,048 m (approximately 10,000 cable-ft)
  - drop-cable length—30.4 m (approximately 100 cable-ft)
- do not connect more than 64 stations on a single DH+ link

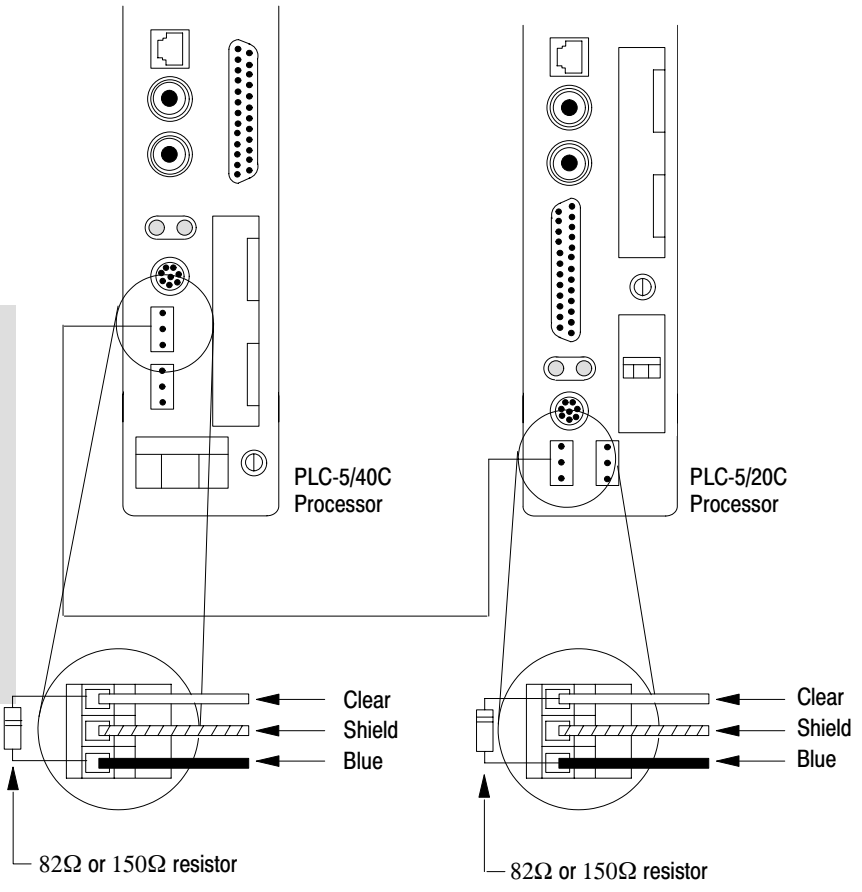
Use the 3-pin connector on the processor to connect a DH+ link. The connector's port must be configured to support a DH+ communication link.

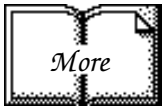
You can install a DH+ link two ways:

- trunk cable/drop cable—from the drop cable to the connector screw terminals on the DH+ connectors of the processor
- daisy chain—to the connector screw terminals on the DH+ connectors of the processor

To make connections:

1. Connect the signal conductor with **clear** insulation to the 3-pin connector terminal 1 at each end of each cable segment.
2. Connect the **shield** drain wire to the center terminal of the 3-pin connector at both ends of each cable segment.
3. Connect the signal conductor with **blue** insulation to the 3-pin connector terminal 2 at each end of each cable segment.





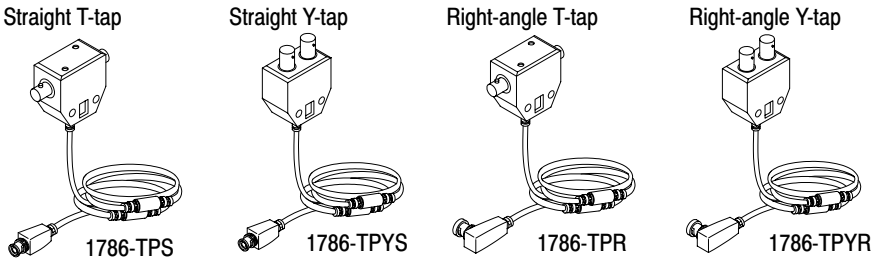
For more information, see the Data Highway/Data Highway Plus/Data Highway II/Data Highway 485 Cable Installation Manual, publication 1770-6.2.2.

Connecting to a ControlNet Network

Connect a ControlNet PLC-5 processor to a ControlNet network via a tap with a 1-m (39.4-in) drop cable.

Four taps are available from Allen-Bradley Company, Inc.:

Tip We recommend that you use a tap with a straight connector—1786-TPS or 1786-TPYS—when you attach a ControlNet PLC-5 processor to a ControlNet network.



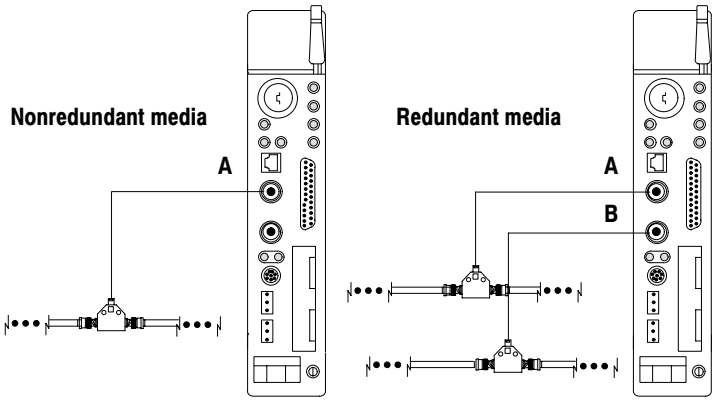
Important: ControlNet taps contain passive electronics and must be purchased from Allen-Bradley Company, Inc. for the network to function properly.

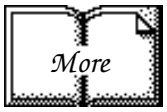
After terminating your segments, you connect your node to the network.

Remove the tap's dust cap—located on the straight or right-angle connector)—and set it aside.

If your network supports:	Connect the tap's straight or right-angle connector:
nonredundant media	to the **channel A** connector on the processor—channel B is not used①
redundant media	• from **trunk-cable A to channel A** on the processor and • from **trunk-cable B to channel B** on the processor

① Allen-Bradley Company, Inc. recommends using channel A for nonredundant media.





For detailed information on planning and installing your ControlNet system, see the following publications:

Publication	Publication Number
ControlNet Cable System Component List	AG-2.2
ControlNet Cable System Planning and Installation Manual	1786-6.2.1
ControlNet Coax Tap Installation Instructions	1786-2.3
ControlNet Network Access Cable Installation Instructions	1786-2.6
ControlNet Repeater Installation Instructions	1786-2.7
Industrial Automation Wiring and Grounding Guidelines	1770-4.1

Connecting a Programming Terminal

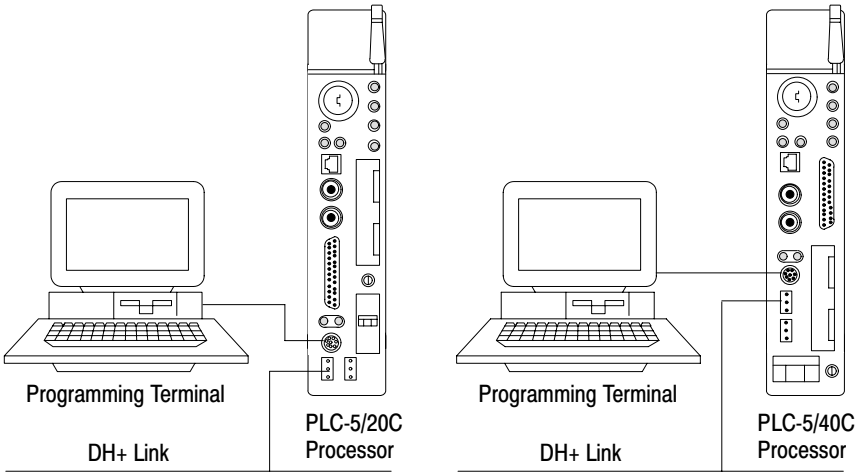
You can connect a programming terminal to a ControlNet PLC-5 processor via a:

- DH+ connection
- serial channel
- ControlNet connection

DH+ Connection

To attach a programming terminal to a ControlNet PLC-5 processor using a DH+ connection:

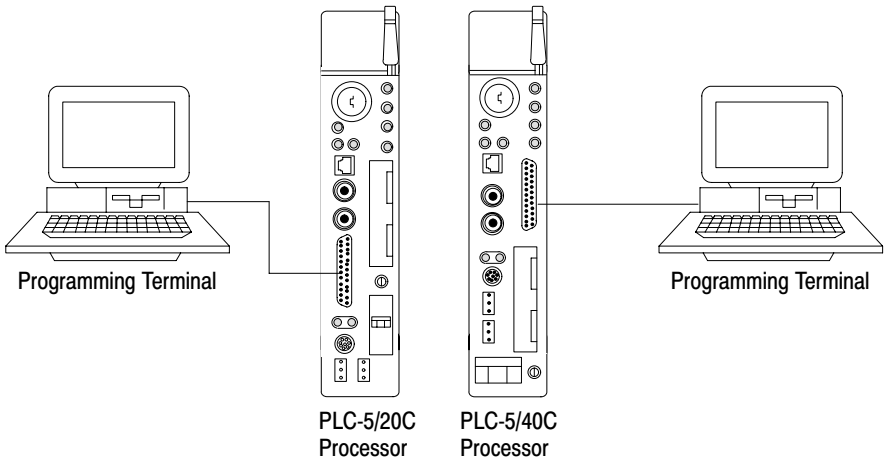
If you use this card to access a DH+ link:	Use cable:
1784-PCMK	▪ 1784-PCM6 ▪ 1784-PCM5 with a 1784-CP7 adapter
1784-KT, -KT2	▪ 1784-CP6 ▪ 1784-CP6 with a 1784-CP7 adapter ▪ 1784-CP8 adapter
1784-KT*x*, -KT*x*D	1784-CP13



Serial Channel

To program the processor using Channel 0, configure the channel for RS-232C using DF1 point-to-point protocol.

If your programming terminal has a:	Use cable:
9-pin serial port	1784-CP10
25-pin serial port	1784-CP11



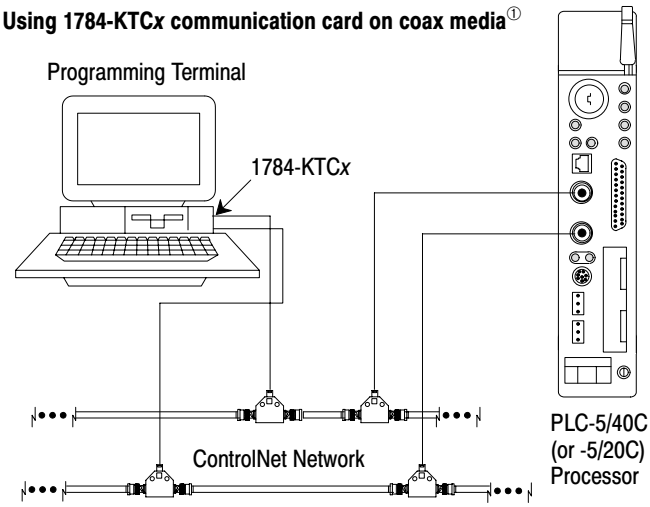
ControlNet Connection

ATTENTION: Do not connect the same communication card to both the NAP and a tap on the ControlNet network.

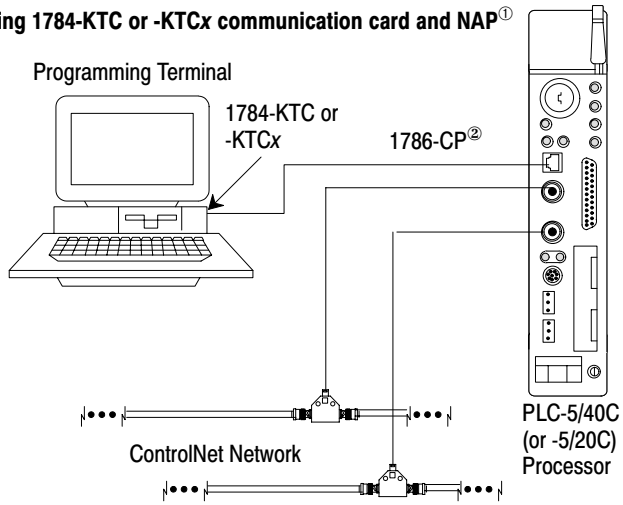
You can connect programming devices to a ControlNet network through:

- the ControlNet network access cable (1786-CP)
- a tap on a ControlNet network

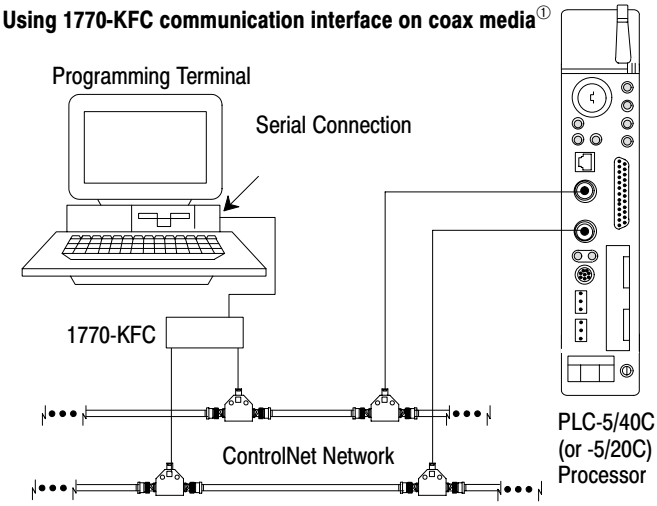
Using 1784-KTC*x* communication card on coax media①



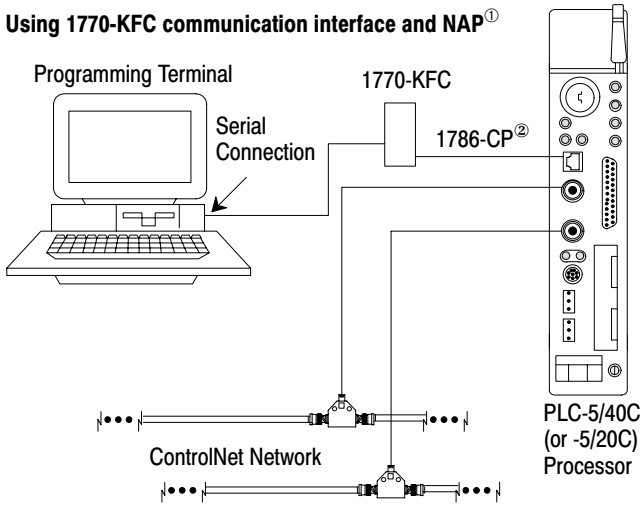
Using 1784-KTC or -KTC*x* communication card and NAP①



Using 1770-KFC communication interface on coax media①



Using 1770-KFC communication interface and NAP①



① Shown with redundant media

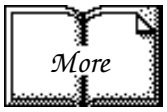
② The network access cable (1786-CP) can be plugged into any ControlNet product's NAP to provide programming capability on the ControlNet network. A programming terminal connected through this cable is counted as a node and must have a unique address.

ATTENTION: Use the **1786-CP** cable when connecting a programming terminal to the network through a NAP. Using a commercially available RJ-style cable could result in network failure.

Selecting Appropriate Cables

This section lists information about:

- serial cables
- DH+ programming cables
- remote I/O cables
- ControlNet cables



For more information about cables, see the Enhanced and Ethernet PLC-5 Programmable Controllers User Manual, publication 1785-6.5.12.

Serial Cables

You can make your own serial cables or purchase them from Allen-Bradley Company, Inc.

The side label of the processor shows the following table, which lists Channel 0 (serial port) pin assignments.

Pin	RS-232C	RS-422A	RS-423
1	C.GND	C.GND	C.GND
2	TXD.OUT	TXD.OUT^{-}	TXD.OUT
3	RXD.IN	RXD.IN^{-}	RXD.IN
4	RTS.OUT	RTS.OUT^{+}	RTS.OUT
5	CTS.IN	CTS.IN^{+}	CTS.IN
6	DSR.IN	DSR.IN	DSR.IN
7	SIG.GND	SIG.GND	SIG.GND
8	DCD.IN	DCD.IN	DCD.IN
9			
10	NOT USED	DCD.IN	NOT USED
11			
12			
13	NOT USED	CTS.IN^{-}	NOT USED

Pin	RS-232C	RS-422A	RS-423
14	NOT USED	TXD.OUT^{+}	SEND COM
15			
16	NOT USED	RXD.IN^{+}	REC COM
17			
18			
19	NOT USED	RTS.OUT^{-}	NOT USED
20	DTR.OUT	DTR.OUT	DTR.OUT
21			
22	NOT USED	DSR.IN	NOT USED
23	NOT USED	DTR.OUT	NOT USED
24			
25			

The shading indicates that the pin is reserved.

This processor's serial port can support these configurations:

Digital Interface	Maximum Cable Length
RS-232C	15 m (approximately 50 ft)
RS-422A (compatible)	61 m (approximately 200 ft)
RS-423	61 m (approximately 200 ft)

Important: Follow these guidelines:

- When Channel 0 is configured for RS-422A compatibility, do not use terminating resistors anywhere on the link.
- When Channel 0 is configured for RS-422A (compatible) and RS-423, do not go beyond 61 m (approximately 200 ft). This distance restriction is independent of the transmission rate.

DH+ Programming Cables

When using this communication card:	Use this cable:
1784-KT, -KT2	• 1784-CP6 • 1784-CP with 1784-CP7 adapter • 1784-CP8 adapter
1784-KL, -KL/B	
1784-KTK1	1784-CP5 with 1784-CP7 adapter
1784-KT*x*, KT*x*D	1784-CP13
1784-PCMK	• 1784-PCM6 • 1784-PCM5 with 1784-CP7 adapter

Remote I/O Cables

Use 1770-CD or cable for remote I/O. See page 1-12 for more information.

ControlNet Cables

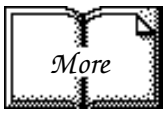
Several types of RG-6 quad-shield cable may be appropriate for your ControlNet installation—depending on the environmental factors associated with your application and installation site.

The following ControlNet cable system components are available from the Allen-Bradley Company, Inc.:

Item[1]		Cat. No.
ControlNet Coax Tool Kit		1786-CTK
Coax Tap Kit	Right-angle T-tap Straight T-tap Right-angle Y-tap Straight Y-tap	1786-TPR 1786-TPS 1786-TPYR 1786-TPYS
Repeaters	High-voltage ac & dc Low-voltage dc	1786-RPT 1786-RPTD
RG-6 Quad Shield Cable	Standard-PVC CM-CL2	1786-RG6
ControlNet Network Access Cable—3.05 m (10 ft)		1786-CP
BNC Connectors	Barrel (plug to plug)	1786-BNCP
	BNC/RG-6 plug	1786-BNC
	Bullet (jack to jack)	1786-BNCJ
	Isolated-bulkhead (jack to jack)	1786-BNCJI
	Terminators (BNC-75Ω)	1786-XT

[1] For a complete list of ControlNet cable system components that are available from Allen-Bradley Company, Inc. and other sources, see the ControlNet Cable System Component List, publication AG-2.2.

Important: Install all wiring for your ControlNet system in accordance with the regulations contained in the National Electric Code (or applicable country codes), state codes, and applicable municipal codes.



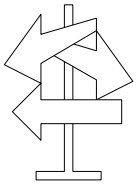
For detailed information on ControlNet cabling, see the following:

Publication	Publication Number
ControlNet Cable System Component List	AG-2.2
ControlNet Cable System Planning and Installation Manual	1786-6.2.1
ControlNet Coax Tap Installation Instructions	1786-2.3
ControlNet Network Access Cable Installation Instructions	1786-2.6
ControlNet Repeater Installation Instructions	1786-2.7
Industrial Automation Wiring and Grounding Guidelines	1770-4.1

Chapter 2

Planning to Use Your ControlNet PLC-5 Processor

Using This Chapter



If you want to read about:	Go to page:
Understanding ControlNet I/O	2-1
Understanding ControlNet I/O mapping	2-7
Using the ControlNet PLC-5 processor in a ControlNet I/O system	2-13
Converting from a remote I/O system to a ControlNet I/O system	2-15

Understanding ControlNet I/O

The ControlNet system is designed to:

- provide high-speed, repeatable, deterministic I/O transmission
- allow control and message information to co-exist on the same physical media
- make sure that I/O data transfers are not affected by
  - programming-terminal message activity
  - inter-PLC processor message activity on the network

Scheduled Data-Transfer Operations on a ControlNet Network

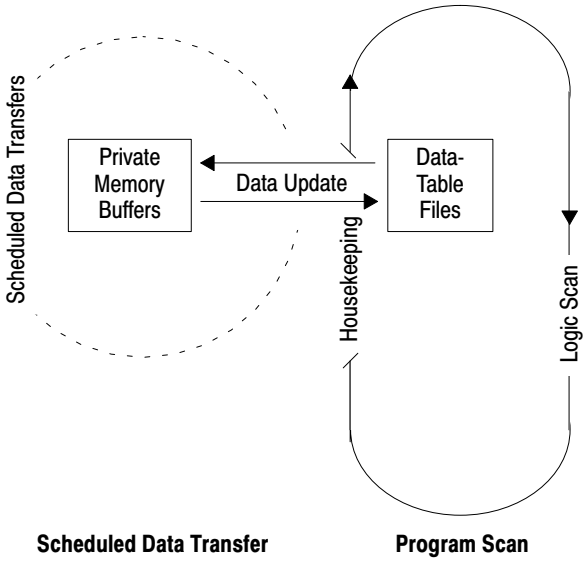
ControlNet scheduled data transfer on a PLC-5/20C or -5/40C processor:

- is continuous
- transmits asynchronous to the ladder-logic program scan
- occurs at the actual rate displayed on the 6200 Programming Software ControlNet I/O Mapping (Monitor) screen in the **`Act Net Pckt Time (ms)`**—Actual Network Packet Time—field

In scheduled discrete I/O data transfer, for example, between logic scans—i.e., during “housekeeping”—the following updates occur:

- the gathered input image is moved from a private memory buffer to the processor’s input-image file for use during the next logic scan
- the data from the output-image file is put into a private memory buffer and is sent during the next scheduled communication

A similar method is used for all scheduled data-transfer operations.



The following scheduled data-transfer operations are supported by the PLC-5/20C and -5/40C processors on a ControlNet network:

Table 2.A
ControlNet Scheduled Data-Transfer Operations

Operation	Description
Discrete I/O Data Transfer	Performed in a deterministic and repeatable manner asynchronous to and independent of the ladder-logic program scan. You configure all ControlNet discrete I/O data transfers on a per-node basis in the I/O map table.①
Non-discrete I/O Data Transfer	Handled with the same priority as discrete I/O data transfer. You can update analog data without using block-transfer instructions in ladder programs. You do this by including non-discrete I/O data-transfer configurations in the I/O map table. This data is updated in the buffers and data-table files between logic scans in the same manner as that used in discrete I/O data transfer.①
Peer-to-peer Communication	Allows the "controlling" processor at network address 01 to communicate with other ControlNet processors on the ControlNet network with the same priority as that of the discrete and non-discrete I/O data transfers discussed above.①

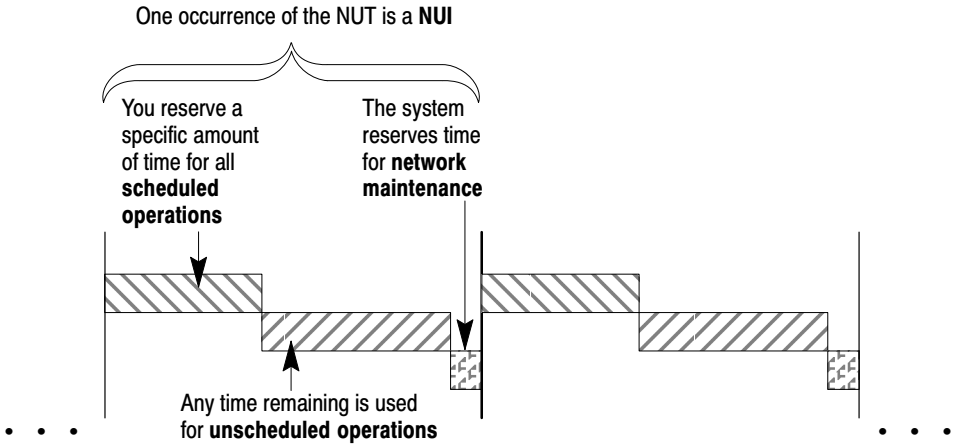
① While scheduled data transfer is asynchronous to program scanning, all data is presented synchronously to the processor and output buffers during housekeeping.

Unscheduled Data-Transfer Operations on a ControlNet Network

The ControlNet network allows you to use unscheduled messaging when deterministic delivery is not required. Unscheduled operations include:

- unscheduled non-discrete I/O data transfers—through ControlNet I/O Transfer (CIO) instructions
- peer-to-peer messaging—through Message (MSG) instructions
- messaging from programming devices

The ControlNet system places your scheduled transfers in the first part of each Network Update Interval (NUI), time is automatically reserved for network maintenance, and unscheduled transfers are performed during the time remaining in the interval.


One occurrence of the NUT is a **NUI**
You reserve a specific amount of time for all **scheduled operations**
The system reserves time for **network maintenance**
Any time remaining is used for **unscheduled operations**

Unscheduled messaging on a ControlNet network is non-deterministic. Your application and your configuration—number of nodes, application program, NUT, etc.—help determine how much time there is for unscheduled messaging.

Important: The ControlNet network reserves time for at least one unscheduled transfer per NUI.

Table 2.B
ControlNet Unscheduled Data-Transfer Operations

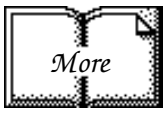
Operation	Description	Features
Non-discrete I/O Data Transfer CIO Instructions	Perform ladder-initiated unscheduled non-discrete I/O data transfers on a ControlNet network by using ControlNet I/O Transfer (CIO) instructions. The data type for these transfers (CT) has the following information: • Command: 1771 READ — reads data from a 1771 non-discrete I/O module 1771 WRITE — writes data to a 1771 non-discrete I/O module 1794 FAULT ACTION — changes the action a module takes when it faults 1794 IDLE ACTION — changes the action a module takes when it is idle 1794 CONFIG DATA — changes a module's configuration data 1794 SAFE STATE DATA — changes a module's safe-state data • Data-table address in source processor • Size of message in words • Network address of destination node • Slot of destination module • Port number—set to 2 for the ControlNet network • Flags: .TO — forces a transfer to time out .EW — indicates that the transfer is waiting for an open connection .CO — transfer is made continuously in Run mode .ER — indicates that the transfer was terminated due to an error .DN — indicates that the transfer was made without error .ST — indicates that the transfer was started .EN — indicates that the transfer instruction is enabled • Error code—indicates the error when the .ER bit is set • Done length—indicates the number of words transferred	• As many as 32 1771 READ and/or 1771 WRITE CIOs can be active at a time① • A minor fault is set when 32 1771 READ and/or 1771 WRITE CIOs are active at a time • You cannot use CIO instructions to read or write blocks of data from or to 1794 Flex I/O modules; but you can use these instructions to configure 1794 features listed in the "Description" column • As many as 8 1794 Flex I/O CIOs can be active at a time① • A minor fault is set when 8 1794 Flex I/O CIOs are active at a time • Any transfer initiated from a Processor Input Interrupt (PII) or Selectable Timed Interrupt (STI) program suspends execution of the program scan until the transfer is completed • **Important:** This can extend your program scan by ten's of ms. • No transfer is initiated when the processor is in Program mode • Transfers that have been running with the .CO bit set automatically restart on the Program-to-Run transition when the Continue Last step bit is set and the data table has not changed • A transfer has a maximum size of 64 words • Only the processor "owner" of an adapter can send or receive transfers to or from any of that adapter's modules See pages 4-4 and C-1 for more information.
Peer-to-peer Messaging MSG Instructions	You can use ControlNet message (MSG) instructions and the data-type MG to create unscheduled messages that are initiated by one ControlNet PLC-5 processor and sent to another ControlNet PLC-5 processor. The MG data type for the ControlNet instruction has the following information: • Command—PLC-5 TYPED READ or PLC-5 TYPED WRITE • Data-table address in source processor • Size of message in elements • Network address of destination processor • Data-table address in destination processor • Port number—set to 2 for the ControlNet network • Flags: .TO — forces a message to time out .EW — indicates that the message is waiting for an open connection .CO — message is sent continuously in Run mode .ER — indicates that the message was terminated due to an error .DN — indicates that the message was sent without error .ST — indicates that the message was started .EN — indicates that the message instruction is enabled • Error code—indicates the error when the .ER bit is set	• As many as 32 ControlNet MSGs can be active at a time① • A minor fault is set when 32 ControlNet MSGs are active at a time • All messages have the same priority • No message is initiated when the processor is in Program mode • Messages that have been running with the .CO bit set automatically restart on the Program-to-Run transition when the Continue Last step bit is set and the data table has not changed • Each message has a maximum size of 1000 elements See pages 4-2 and C-1 for more information.

Operation	Description	Features

① Because connections are opened and closed as needed, more can exist in a program as long as no more than this number are active at one time.

Using I/O Forcing Operations

ControlNet I/O forcing occurs in the same way as remote I/O forcing in the PLC-5/20 and -5/40 processors. The processor performs the forcing and transmits the forced data to the output- and input-image tables. You can force any discrete I/O data placed in the I/O image; however, forcing of non-discrete I/O data is not supported.



For detailed information on forcing, see PLC-5 Programming Software Configuration and Maintenance, publication 6200-6.4.6.

Using Immediate Data-Transfer Operations

ControlNet Immediate Data I/O transfers—Immediate Data Input (IDI) and Immediate Data Output (IDO)—perform similarly to the remote-I/O supported immediate I/O transfers—Immediate Input (INN) and Immediate Output (IOT)—which the ControlNet system also supports. The logic scan is temporarily interrupted while the most recent state of one discrete input or output word is read from or written to the private memory buffer.

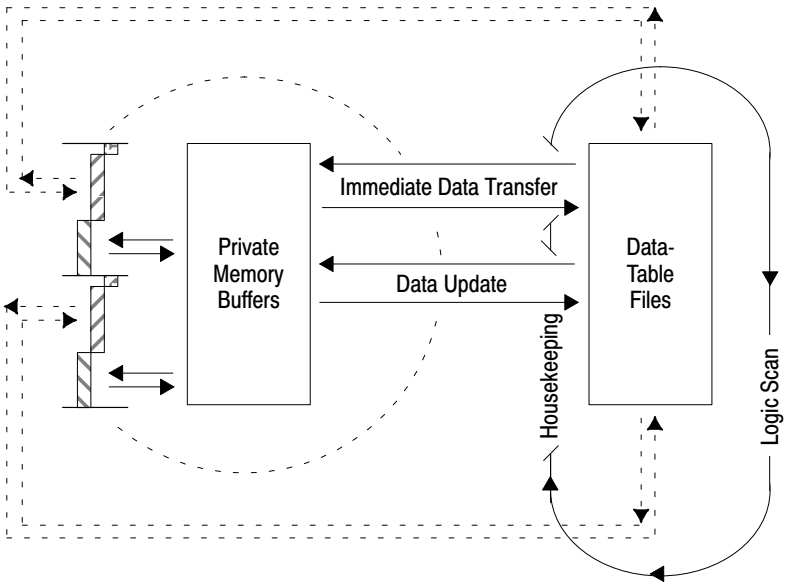


Table 2.C
ControlNet Immediate Data-Transfer Operations

Instructions	Description
Immediate I/O—ControlNet and Remote I/O 001 —(IIN)— 001 —(IOT)—	In the case of an IIN, the most recent copy of the specified input word secured in the last discrete I/O data transfer from the corresponding I/O chassis is used. This value is moved from the private memory buffer to the working data table and is used in all subsequent ladder instructions. This data could be as old as the time taken since the last asynchronous I/O update, and it may not actually reflect the latest state of the input word. In the case of an IOT, the current state of the specified output word is copied to the private memory buffer and is used on the next output update to the I/O chassis. The actual change is not communicated until the next asynchronous I/O transfer. Only 1 word of I/O data can be updated per instruction.
ControlNet Immediate Data I/O IDI IMMEDIATE DATA INPUT Data file offset 232 Length 10 Destination N11:232 IDO IMMEDIATE DATA OUTPUT Data file offset 175 Length 24 Source N12:175	The ControlNet Immediate Data I/O instructions work in much the same way as the immediate I/O instructions. During an input instruction, the most recent data is copied from the private memory buffer to a data-table address that you specify. In the case of an output instruction, the data is copied from an area that you specified to the private memory buffer and sent on the next I/O update. As many as 64 words can be transferred per instruction. **Important:** In most cases, you should set the Data file offset and the Source—of an IDO—or the Data file offset and the Destination—of an IDI—to the same address. See page 4-6 for more information on this and other aspects of using ControlNet IDI and IDO instructions.

Understanding ControlNet I/O Mapping

All scheduled data transfers must be mapped on a ControlNet network. You specify where I/O data is to be read from or written to—i.e., mapped. You do this and establish the relationship between processors, I/O adapters, and data-table file addresses by creating and maintaining an I/O map table. An I/O map-table entry is required for each scheduled data transfer. The map table is stored in the configuration section of memory and is not accessible by your application program.

Using the 6200 PLC-5 Programming Software, you can automatically configure and map nodes attached to your ControlNet I/O. See Chapter 3 for information on ControlNet automatic configuration and I/O mapping.

Reserving Space for Non-ControlNet I/O

Non-ControlNet processor-resident local I/O and remote-I/O devices can only use fixed I/O image locations based on rack number for discrete I/O data transfer, while discrete I/O data transfer between ControlNet nodes can be mapped to any unused location in the I/O image tables. Before mapping your ControlNet I/O, therefore, you should configure any processor-resident local I/O and any remote I/O racks on non-ControlNet channels. This allows the 6200 PLC-5 Programming Software to reserve input- and output-image space for all non-ControlNet processor-resident local I/O and remote-I/O chassis.

Processor-Resident Local I/O

If you first configure processor-resident local I/O on your processor, the 6200 PLC-5 Programming Software reserves processor-resident local chassis input- and output-image space starting at offset 0 in both files.

The following table shows the default number of input and output words automatically reserved by the 6200 PLC-5 Programming Software for the different sizes and addressing modes of processor-resident local I/O:

Addressing Mode	Number of Words Reserved			
	4 Slots	8 Slots	12 Slots	16 Slots
2 Slot	8	8	8	8
1 Slot	8	8	16	16
1/2 Slot	8	16	24	32

Important: ControlNet I/O cannot map into any part of a rack number used by the processor-resident rack.

Remote I/O

The following table shows the default number of input and output words reserved by the 6200 PLC-5 Programming Software for the different sizes and addressing modes of non-ControlNet remote I/O if you first configure non-ControlNet remote I/O on your processor:

Addressing Mode	Number of Words Reserved			
	4 Slots	8 Slots	12 Slots	16 Slots
2 Slot	2	4	6	8
1 Slot	4	8	12	16
1/2 Slot	8	16	24	32

The 6200 PLC-5 Programming Software reserves non-ControlNet remote-I/O output- and input-image space according to these guidelines:

- It does not overlap processor-resident local I/O reserved image space
- It addresses input- and output-image space offset in octal from
  - 00-37—for the PLC-5/20C processor
  - 00-177—for the PLC-5/40C processor
- The output-image offset value in the I/O map corresponds to the first slot of the referenced chassis—i.e., in a 4-slot chassis set for 1-slot addressing, the corresponding output-image offset of O:10 would map the words O:10, O:11, O:12, and O:13 to slots 0, 1, 2, and 3 respectively
- The input-image offset corresponds to the first slot in the referenced rack, and the offset location of the input modules in that rack corresponds to the same offset in the image table—i.e., if a chassis set for 1-slot addressing has an input-image offset of I:10 and an input module in slot 3 (of 0-7), the word that corresponds to that input module would be I:10 + 3, or I:13

Mapping ControlNet Data Transfer

The ControlNet I/O map table can contain up to 64 entries. Each map-table entry corresponds to one transfer—either input or output—of data between the ControlNet processor and an I/O rack, an I/O module, or another ControlNet processor.

Table 2.D
Number of ControlNet I/O Map-Table Entries Required

Data-Transfer Type	Number of Entries Required
1771 Discrete I/O Data Transfer	1 per adapter
1771 Non-discrete I/O Data Transfer	1 or 2 per module
1794 Discrete and Non-discrete I/O Data Transfer	2 per adapter
ControlNet PLC-5 Peer-to-peer Communication	1 per message

Table 2.E
Files That You Configure with the I/O Map for Scheduled I/O Usage

File	Description
Status File	User-specified integer data-table file containing status information about all of the ControlNet network's scheduled I/O map-table entries. Each entry has a status-file offset field pointing to three status words associated with the entry.
Data Input File (DIF)	User-specified integer data-table file with a maximum of 1000 words. This space is used for both non-discrete input data and peer-to-peer input over the ControlNet network. Scheduled peer-to-peer inputs can also use the input-image file.
Data Output File (DOF)	User-specified integer data-table file with a maximum of 1000 words. This space is used for both non-discrete output data and peer-to-peer output over the ControlNet network. Scheduled peer-to-peer outputs can also use the output-image file.
Default Configuration File	User-specified integer data-table file used to store non-discrete I/O data transfer configuration data when the automatic-mapping feature is used.

Table 2.F
ControlNet I/O Map-Table Entry Fields

Map-Table Entry Field	Description
Node and Slot/Message Numbers	This is the entry's network location, currently defined as *node.slot/message*. The node value is the ControlNet network address of the destination device. The slot/message value takes on different meanings with the different communication options: • 1771 and 1794 discrete I/O data transfer—the slot value does not apply because the mapping granularity is based on the physical chassis • 1771 non-discrete I/O data transfer—0-15, the slot number is always the physical slot location inside the 1771 chassis regardless of addressing mode within the chassis • 1794 non-discrete I/O data transfer—0-7, the slot number is always the physical location in the 1794 system • peer-to-peer communication—1-16, the message number represents one of sixteen scheduled peer messages available per processor; and it must be the same for both processors involved
Module/Message Type	This allows you to specify the module type or peer-to-peer message type—Peer Out or Peer In—in offline and online programming. It also determines how the map-table entries are configured for the different modules and peer-to-peer messages.
Expected Network Packet Time (ENPT)	You set this to the maximum time allowed for the network to update the requested data.
Actual Network Packet Time (ANPT)	This read-only field displays the actual time it takes for the network to update the requested data.

Map-Table Entry Field	Description
Input File and Size	This is the offset in the input file where the data is to be stored and the number of words to be received from the input device. For discrete I/O data transfer, the offset is into the input-image table; for non-discrete I/O data transfer or peer-to-peer communication with another ControlNet processor, the offset is into the Data Input File entered on the ControlNet configuration screen. Scheduled peer-to-peer inputs can also use the input-image file.
Output File and Size	This is the offset in the output file where the data is located and the number of words of the output transfer. For discrete I/O data transfer, the offset is into the output-image table; for non-discrete I/O data transfer or peer-to-peer communication with another ControlNet processor, the offset is into the Data Output File (DOF) entered on the ControlNet configuration screen. Scheduled peer-to-peer outputs can also use the output-image file.
Status File Offset	This is an offset in a status file that points to three words of information on the status of this map-table entry.
Configuration File and Size	Used only in 1771 non-discrete I/O data transfer and 1794 configurations, this is the offset in a configuration file where configuration information needed for this node is located and the size in words of the information.

Discrete I/O Data-Transfer Mapping

Regardless of the type of I/O—e.g., 1771, 1794—all ControlNet discrete I/O data is stored within the processor's I/O image files according to the corresponding I/O map-table entry. Any status information transferred along with the I/O data is stored in a separate status file that you specify during configuration.

Non-discrete I/O Data-Transfer Mapping

All ControlNet non-discrete I/O data is stored in integer files that you specify in a ControlNet configuration screen. The ControlNet processor supports two distinct image files; both are integer data-table files that you specify:

- Data Input File (DIF)
- Data Output File (DOF)

Each map-table entry for a non-discrete I/O data transfer defines an offset into the DIF or DOF where the data is stored. Using separate data-table files for non-discrete I/O data transfer allows the processor to present non-discrete I/O data in the same way as discrete I/O data—continuously transmitted and asynchronous to the ladder-logic program scan.

1771 Modules

ControlNet 1771 discrete I/O data-transfer mapping requires one map-table entry per module. ControlNet 1771 non-discrete I/O data-transfer mapping requires one or two map-table entries per module, depending on the module type.

The PLC-5/20C and -5/40C ControlNet non-discrete I/O data-transfer mechanism makes it possible to eliminate block-transfer programming to communicate with the 1771 modules listed in Table 2.G.

Table 2.G
1771 Non-discrete I/O Data-Transfer Mapping

Module Type	Description[1][2]	Default Entries per Module	Default Input Size	Valid Input Size(s)	Default Output Size	Valid Output Sizes	Default Config. Size	Valid Configuration Sizes
1771-CFM/A	1771-CFM/A Configurable Flowmeter Module	2	41	0-41	60	0-4, 14, 24, 34, 44, 48, 52, 56, 60	60	0-4, 14, 24, 34, 44, 48, 52, 56, 60
1771-DE/A	1771-DE/A Absolute Encoder Module	2	2	0, 2	20	0, 5, 10, 15, 20, 22	20	0, 5, 10, 15, 20, 22
1771-IE	1771-IE Analog Input Module	1	8	1-8				
1771-IF	1771-IF Analog Input Module	1	8	1-64				
1771-IFE/A	1771-IFE/A Analog Input Module	1	20	5-20			37	0, 3, 37
1771-IFE/B	1771-IFE/B Analog Input Module	1	20	5-22			37	0, 3, 37, 39
1771-IJ	1771-IJ Encoder/Counter Module	2	1	0, 1	3	0-3	3	0-3
1771-IK	1771-IK Encoder/Counter Module							
1771-IL/A	1771-IL/A Isolated Analog Input Mod.	1	12	5-12			19	0, 2, 19
1771-IL/B	1771-IL/B Isolated Analog Input Mod.	1	12	5-15			19	0, 2, 19, 36, 37
1771-IR/A	1771-IR/A RTD Input Module	1	8	3-8			14	0, 2, 8, 14
1771-IR/B	1771-IR/B RTD Input Module	1	8	3-9			14	0, 2, 8, 14, 15
1771-IS	1771-IS Multiplexer Input Module	1	6	1-7				
1771-IXE/A	1771-IXE/A Thermocouple/Millivolt Input Module	1	12	4-12			27	0, 1, 19, 27
1771-IXE/B	1771-IXE/B Thermocouple/Millivolt Input Module	1	12	4-13			27	0, 1, 19, 27, 28
1771-IXHR/A	1771-IXHR/A High-resolution Thermocouple/Millivolt Input Module	1	12	4-13			27	0, 3, 19, 27, 28
1771-OF	1771-OF Analog Output Module	2	1	0-1	4	4-60		
1771-OFE/A	1771-OFE/A Analog Output Module	2	5	0, 5	13	1-5, 13	13	0, 5, 13
1771-OFE/B	1771-OFE/B Analog Output Module							
N-Series/A	1771 N-Series Analog Module	2	28	0, 20-28	59	0, 2-9, 59	59	0, 2-9, 59
1771-QA	1771-QA Stepper Positioning Module	1	4	1-10				
1771-QB	1771-QB Linear Positioning Module	1	5	1-33				
1771-QC	1771-QC Servo Positioning Module	1	6	1-14				
1771-SN	1771-SN Sub I/O Scanner Module	2	16	0, 7-63	16	0, 7-63		
1771-VHSC/A	1771-VHSC Very High-speed Counter Module	2	18	0, 4-26	64	0-2, 4, 12, 20, 24, 29, 34, 39, 44, 49, 54, 59, 64	64	0-2, 4, 12, 20, 24, 29, 34, 39, 44, 49, 54, 59, 64
1771-Generic	1771 Generic Module[3]	1	1	0-64	1	0-64	1	0-64

[1] ENPT Default = 4 x NUT

[2] ENPT Range = 2-15000 ms

[3] For newly released modules or modules that can have multiple configurations but only one configuration is being used, you can use the generic module type and specify the input and/or output sizes.

The types of modules that may be accommodated by the processor's scheduled non-discrete I/O data-transfer mechanism are typically those modules that require a one-time configuration and then continuously read or write.

To communicate with the modules listed in Table 2.G as well as with other 1771 analog modules, you can also include explicit CIO instructions in your ladder-logic program. See pages 4-4 and C-1 for more information.

1794 Modules

ControlNet 1794 Flex I/O mapping requires two map-table entries per adapter.

The ControlNet scheduled transfer mechanism makes it possible to map the 1794 modules listed in Table 2.H.

Table 2.H
1794 Flex I/O Data-Transfer Mapping

Module Type	Description[1][2]	Default Input Size	Valid Input Size(s)	Default Output Size	Valid Output Size
`1794-OE4/A`	1794-OE4/A Analog Output Module	1		4	
`1794-IE4XOE2/A`	1794-IE4XOE2/A Analog I/O Module	5	1-5	2	
`1794-IE8/A`	1794-IE8/A Analog Input Module	9	1-9		

① ENPT Default = 4 x NUT
② ENPT Range = 2-15000 ms

Other ControlNet Processors

ControlNet scheduled peer-to-peer communications between ControlNet processors require one map-table entry per message. The PLC-5 processor at node 01, the controlling processor, must be included in each message.

The ControlNet transfer mechanism makes it possible to map the scheduled peer-to-peer messages listed in Table 2.I.

Table 2.I
Peer-to-Peer Communications Mapping

Message Type	Description[1][2]	Default Input Size	Valid Input Sizes
`Peer In`	Scheduled Peer In	64	1-64
`Peer Out to __`	Scheduled Peer Out		

① ENPT Default = 4 x NUT
② ENPT Range = 2-15000 ms

To communicate between any ControlNet PLC-5 processors on the ControlNet network, you can include explicit MSG instructions in your ladder-logic program. See pages 4-2 and C-1 for more information.

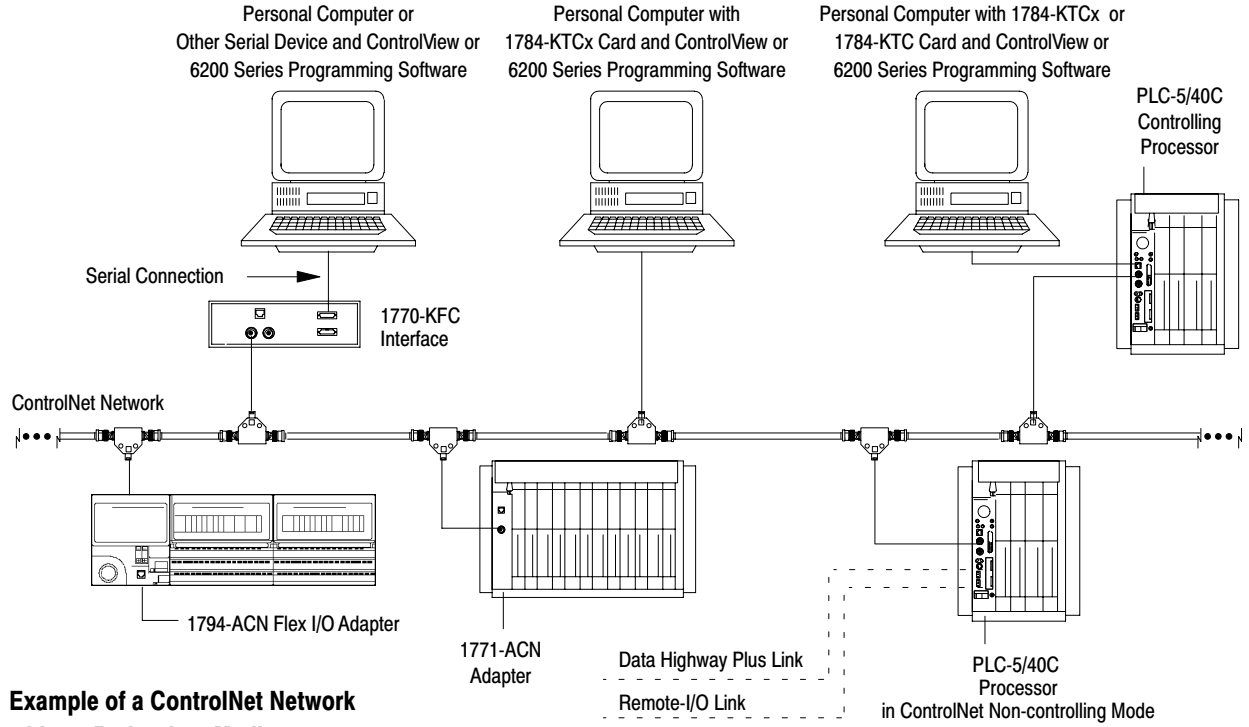
Using the ControlNet PLC-5 Processor in a ControlNet I/O System

There can be only one PLC-5/20C or -5/40C processor updating I/O adapters on a ControlNet network.

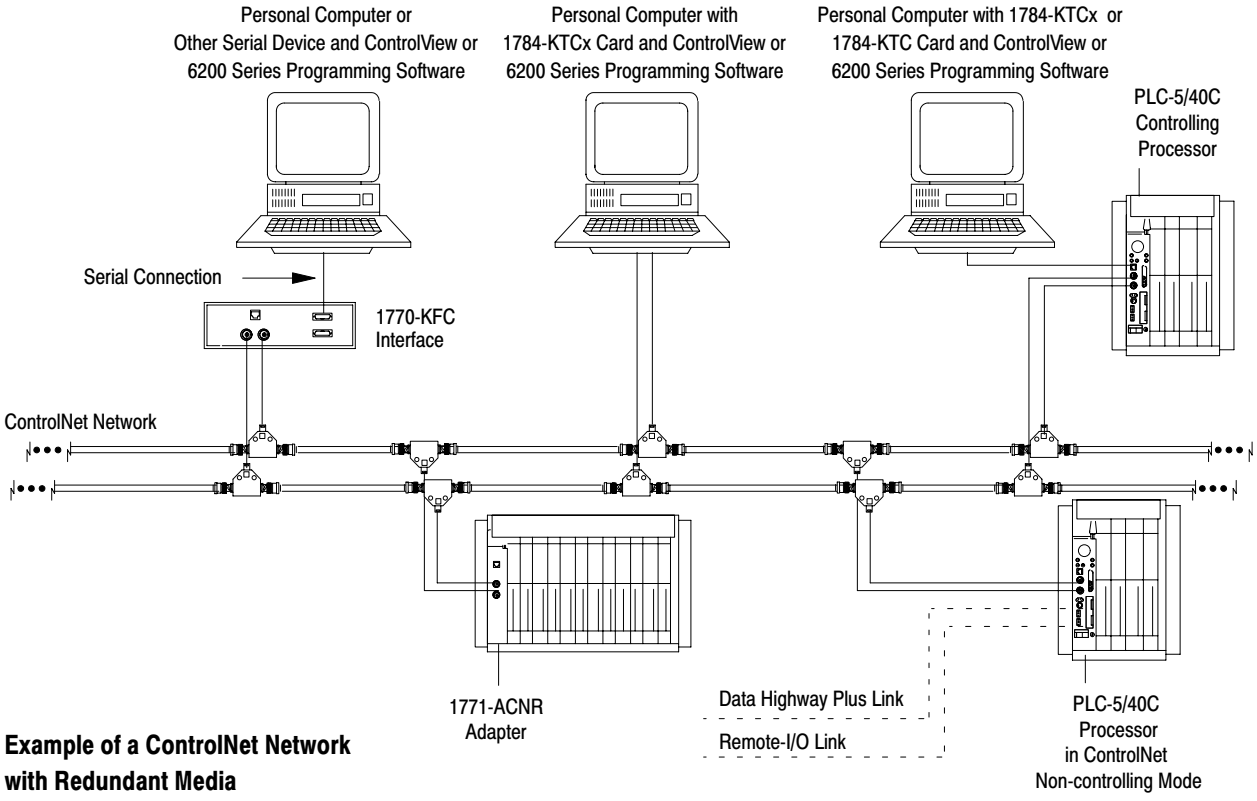
- the PLC-5/20C or -5/40C processor updating the I/O adapters must be at network address 01—this is the “controlling” processor
- only the controlling processor is allowed to send CIO instructions
- additional PLC-5/20C or -5/40C processors can do scheduled transfers to the PLC-5/20C or -5/40C processor at node 01 by using peer-to-peer communications through the map table, but they cannot directly communicate with or control the ControlNet remote I/O

In addition to your controlling processor, you can attach the following ControlNet devices to your network:

Catalog Number(s)	Device(s)	Function
1785-L20C, -L40C	PLC-5/20C and -5/40C Programmable Controllers	Communicate with other PLC-5/20C or -5/40C processors using scheduled or unscheduled peer-to-peer communication
1784-KTC	ControlNet KTC Communication Card	Allows other computer platforms to communicate with the ControlNet network; for programming only
1784-KTC*x*	ControlNet KTC*x* Communication Card	Allows other computer platforms to communicate with the ControlNet network; supports redundant media; for programming MMI
1770-KFC	ControlNet Serial/Parallel Communication Interface	Connects a serial or parallel device to a ControlNet network; supports redundant media
1771-ACN	1771 ControlNet I/O Adapter	Allows the PLC-5/20C or -5/40C processor remote access to Allen-Bradley’s family of 1771-designated I/O modules via a ControlNet network; nonredundant only
1771-ACNR	1771 ControlNet I/O Adapter	Allows the PLC-5/20C or -5/40C processor remote access to Allen-Bradley’s family of 1771-designated I/O modules via a ControlNet network; supports redundant media
1794-ACN	1794 ControlNet Flex I/O Adapter	Allows the PLC-5/20C or -5/40C processor remote access to Allen-Bradley’s family of 1794-designated I/O modules via a ControlNet network; nonredundant only



Example of a ControlNet Network without Redundant Media



Example of a ControlNet Network with Redundant Media

See page 3-4 for more information on ControlNet node configuration.

Converting from a Non-ControlNet Remote I/O System to a ControlNet I/O System

When you download archived files to a PLC-5/20C or -5/40C processor, the 6200 PLC-5 Programming Software ignores Channel 2 configuration information from anything other than a ControlNet-processor program because Channel 2 is reserved for ControlNet communication on the PLC-5/20C and -5/40C processors. The software sets Channel 2 to the ControlNet default configuration.

Program files① for this process:	Archived from a:	On channel:	Can be run on a PLC-5/20C or -5/40C channel:	If they fit and are:
Messaging and I/O	• PLC-5/11 • PLC-5/40E • PLC-5/20 • PLC-5/40L • PLC-5/20C • PLC-5/60 • PLC-5/20E • PLC-5/60L • PLC-5/30 • PLC-5/80 • PLC-5/40 • PLC-5/80E • PLC-5/40C	0	0	downloaded unchanged
		1A	1A	
	• PLC-5/20 • PLC-5/40E • PLC-5/20C • PLC-5/40L • PLC-5/20E • PLC-5/60 • PLC-5/30 • PLC-5/60L • PLC-5/40 • PLC-5/80 • PLC-5/40C • PLC-5/80E	1B	1B	
	• PLC-5/20C • PLC-5/40C	2	2	
	• PLC-5/11 • PLC-5/40E • PLC-5/20 • PLC-5/40L • PLC-5/20C • PLC-5/60 • PLC-5/20E • PLC-5/60L • PLC-5/30 • PLC-5/80 • PLC-5/40 • PLC-5/80E • PLC-5/40C	1A	2	performed by the ControlNet network—you must make these changes manually by reprogramming②③④
	• PLC-5/20 • PLC-5/40E • PLC-5/20C • PLC-5/40L • PLC-5/20E • PLC-5/60 • PLC-5/30 • PLC-5/60L • PLC-5/40 • PLC-5/80 • PLC-5/40C • PLC-5/80E	1B	2	
	• PLC-5/40 • PLC-5/80 • PLC-5/60	2A or 2B	2	
			1A or 1B	performed by DH+ or remote I/O—you must make these changes manually by reprogramming⑤

Program files① for this process:	Archived from a:	On channel:	Can be run on a PLC-5/20C or -5/40C channel:	If they fit and are:
I/O	• PLC-5/20E • PLC-5/60L • PLC-5/40E • PLC-5/80E • PLC5/40L	2	1A or 1B	performed by remote I/O—you must make these changes manually by reprogramming⑤
			2	performed by the ControlNet network—you must make these changes manually by reprogramming③④⑤

① These include processor files, data-table files, and port configurations.

② If you do not update the program, the ControlNet processor will fault.

③ You must change block-transfer instructions for the ControlNet system from the standard block transfer read (BTR) and block transfer write (BTW) instructions to scheduled transfers or to unscheduled CIO instructions.

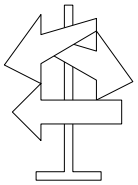
④ You must edit non-ControlNet PLC-5 programs containing references to the I/O Status File for use with I/O connected via the ControlNet network. Information regarding ControlNet status is stored in a separate data file that you specify through the 6200 PLC-5 Programming Software.

⑤ If you do not update the program, the data-table locations corresponding to the “missing” I/O devices will not be updated.

Chapter 3

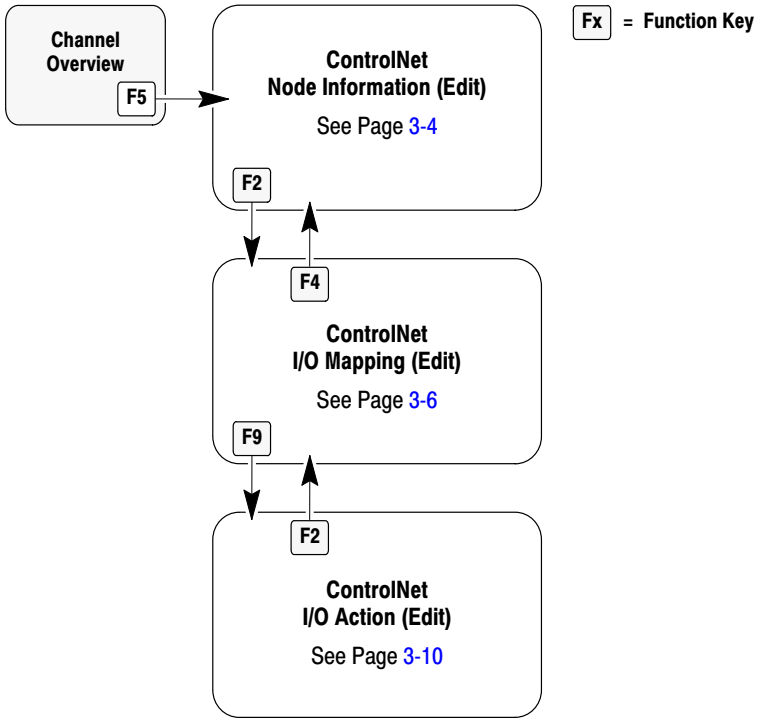
Configuring Your ControlNet System

Using This Chapter

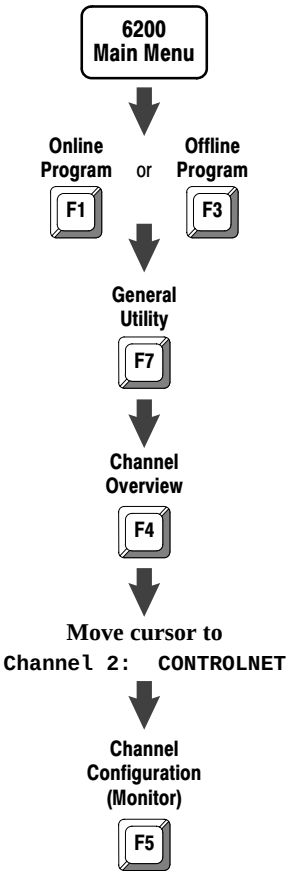


If you want to read about:	Go to page:
Matching the processor configuration with the ControlNet configuration	3-2
Defining local rack characteristics	3-3
Editing the ControlNet node information	3-4
Editing ControlNet I/O mapping	3-6
Editing ControlNet 1794 I/O module action	3-10

ControlNet Configuration Edit Screens in the 6200 Programming Software



Matching the Processor Configuration with the ControlNet Configuration



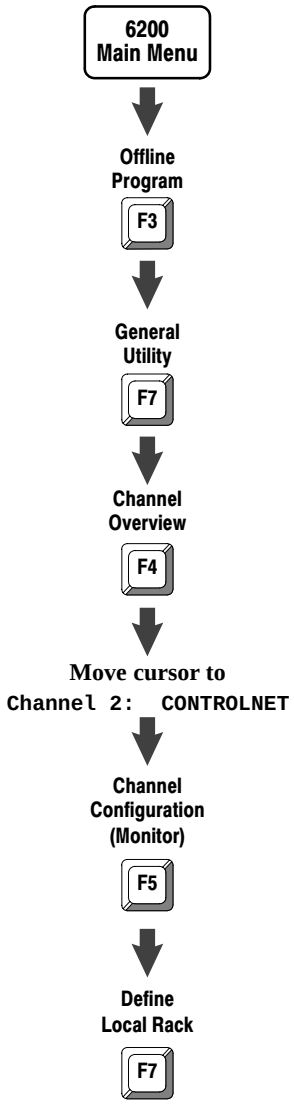
Follow the steps on the left to go to the ControlNet Node Information (Monitor) screen. If the ControlNet information in the processor does not match that on the current ControlNet link, the software redisplays the Channel Overview screen with a new prompt and set of function keys.

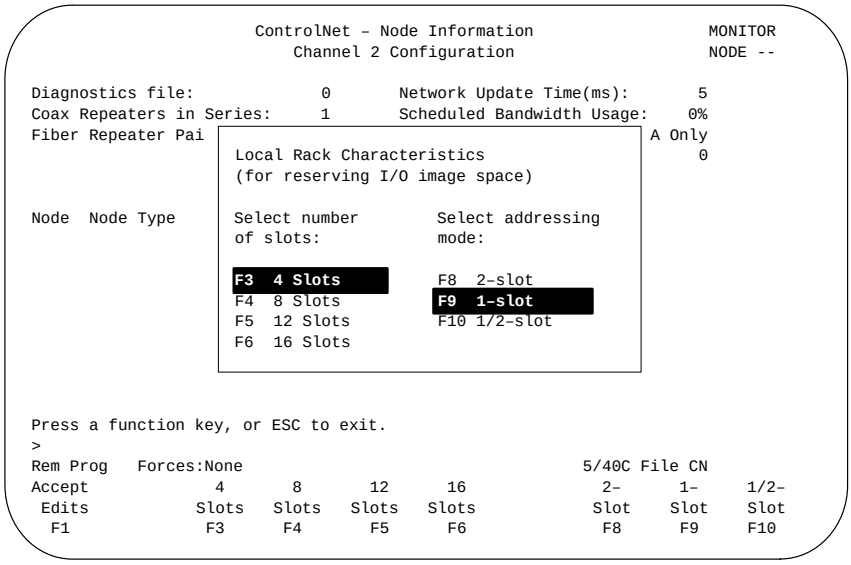
```
                          Channel Overview


Channel 0:  SYSTEM (POINT-TO-POINT)

Channel 1A:                    DH+
Channel 1B:             SCANNER MODE
Channel 2:               CONTROLNET


Channel 3A:                UNUSED


PROCESSOR CONFIGURATION IS INCONSISTENT WITH CURRENT CONTROLNET CONFIGURATION.
Press F10 apply processor to CNet.
>
Rem Prog   Forces:None                                  5/40C File CN
                                                                  Apply
                                                                to Link
                                                                  F10
```

If you want to:	Do this:
apply the processor configuration information to the current ControlNet link configuration, then go to the ControlNet Node Information (Monitor) screen	Press **[F10]—Apply to Link**
return to the original Channel Overview screen	Press **[Esc]**

Defining Local Rack Characteristics

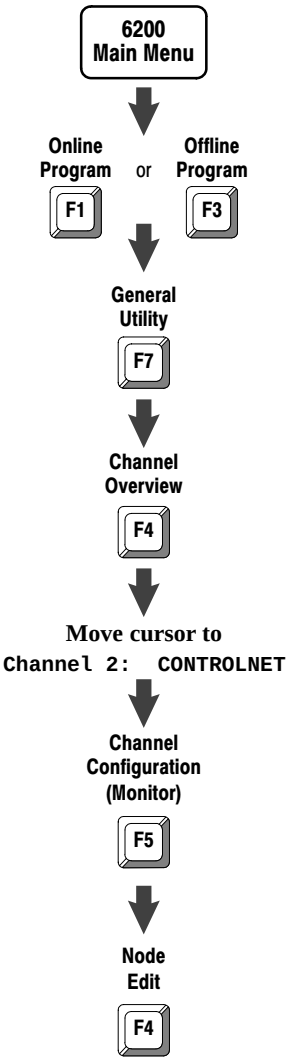
If you are programming offline, configuring Channel 2 for the first time, and entering an edit screen for the first time—or if you follow the steps on the left—the software prompts you to select the number of slots in the local chassis and your addressing mode.





If you have:	Press:	If you want to:	Do this:
4 slots	**[F3]— 4 Slots**	apply pending edits and go to the ControlNet Node Information (Edit) screen	**1.** Press **[F1]—Accept Edits** The software prompts you to enter the node number of your processor **2.** Type the node number of your processor **3.** Press **[Enter]**
8 slots	**[F4]— 8 Slots**		
12 slots	**[F5]— 12 Slots**		
16 slots	**[F6]— 16 Slots**		
2-slot addressing	**[F8]— 2-Slot**	return to the Channel Overview screen	Press **[Esc]**
1-slot addressing	**[F9]— 1-Slot**		
1/2-slot addressing	**[F10]— 1/2-Slot**		

Editing ControlNet Node Information



Follow the steps on the left to go to the ControlNet Node Information (Edit) screen.

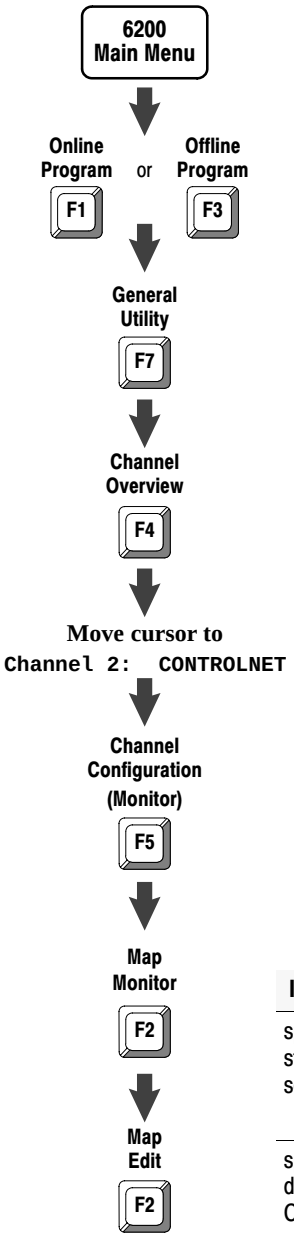
Important: Only one user on a network can enter a processor's ControlNet Node Information (Edit) screen at one time.

```
                    ControlNet - Node Information                  EDIT
                        Channel 2 Configuration                    NODE  1

Diagnostics File:             N12        Network Update Time(ms):        5
Coax Repeaters in Series:       1        Scheduled Bandwidth Usage:    64%
Fiber Repeater Pairs:           0        Media Redundancy Usage:    A Only
                                         Maximum Scheduled Node:        10


Node  Node Type       Series/Revision    Status

  1   PLC-5/40C            C/H           ACTIVE
  2   1771-ACN             A/A           ACTIVE
  3   PLC-5/20C            C/H           ACTIVE
  4   1794-ACN             A/A           ACTIVE


Press a function key, page up or page down, or enter a value.
>
Rem Prog   Forces:None                                  5/40C File CN
Accept     Map   Move    Copy    Auto   Delete  Insert  Delete          Select
 Edits     Edit  Entry   Entry  Network  List   to List  Item           Option
  F1        F2    F3      F4      F5      F6      F7      F8             F10
```

If you want to:	Do this:
specify and create a diagnostics file	**1.** Move the cursor to the **`Diagnostics File`** field **2.** Type an integer file number between N3 and N999 **3.** Press **`[Enter]`**
specify the number of coax repeaters in series that you are using in your ControlNet network	**1.** Move the cursor to the **`Coax Repeaters in Series`** field **2.** Type a number from 0 through 5 **3.** Press **`[Enter]`**
specify the number of pairs of fiber-optic repeaters that you are using in your ControlNet network	**1.** Move the cursor to the **`Fiber Repeater Pairs`** field **2.** Type 0, 1, or 2 **3.** Press **`[Enter]`**
enter the length of fiber cable between repeaters for any fiber-optic repeater pairs that you specify **Important:** The field(s) for fiber-cable length only appear if the number of fiber-optic repeater pairs is not zero.	**1.** Move the cursor to the appropriate **`Pair #x length (meters)`** field **2.** Type a number between 100 and 25500 (the software rounds up to the nearest 100) **3.** Press **`[Enter]`**
specify the NUT—the repetitive time interval during which data can be sent over the ControlNet network **Important:** All nodes do not need to transmit each NUI; however, the NUT defines the minimum time during which a node can transfer scheduled data.	**1.** Move the cursor to the **`Network Update Time (ms)`** field **2.** Type a number between 2 and 100 **3.** Press **`[Enter]`**

If you want to:	Do this:
view the percent of scheduled bandwidth used in the worst case—a percent that changes depending on the ControlNet configuration	See the **Scheduled Bandwidth Usage** field
specify the redundancy characteristic for the ControlNet channel	1. Move the cursor to the **Media Redundancy Usage** field 2. Press **[F10]—Select Option** to toggle to **A/B**, **A Only**, or **B Only**
specify the node with the highest network address that can use scheduled time on the ControlNet link	1. Move the cursor to the **Maximum Scheduled Node** field 2. Type a number between 1 and 99 3. Press **[Enter]**
change a node's type	1. Move the cursor to the entry's **Node Type** field 2. Press **[F10]—Select Option** to toggle to your selection; or enter a unique substring of the name of the new node type
change a node's series or revision	1. Move the cursor to the entry's **Series/Revision** field 2. Press **[F10]—Select Option** to toggle to your selection
change a node's status to active—node is a working/ communicating node on the ControlNet network—or inactive—configuration and map- ping for node are included in computation of NUT, etc.; but device is not actually connected to the network	1. Move the cursor to the entry's **Status** field 2. Press **[F10]—Select Option** to toggle to **Active** or **Inactive**
go to the ControlNet I/O Mapping (Edit) screen	1. Press **[F2]—Map Edit** 2. Go to page 3-6
move a node description to an unused network address	1. Move the cursor to one of the node's cursorable fields 2. Press **[F3]—Move Entry** 3. Type the new network address 4. Press **[Enter]**
copy node information to a different network address	1. Move the cursor to one of the original node's cursorable fields 2. Press **[F4]—Copy Entry** 3. Type the new network address 4. Press **[Enter]**
automatically add nodes connected to the channel to the node list if you are programming online	Press **[F5]—Auto Network**
delete all nodes from the list except for the processor that you are editing	Press **[F6]—Delete List**
insert an entry or range of entries into the node list	1. Press **[F7]—Insert to List** 2. Type a new network address or range of network addresses—e.g., 5-10 3. Press **[Enter]**
delete an entry from the node list	1. Move the cursor to one of the node's cursorable fields 2. Press **[F8]—Delete Item**
apply pending edits and return to the ControlNet Node Information (Monitor) screen	Press **[F1]—Accept Edits**
return to the ControlNet Node Information (Monitor) screen without saving any pending edits	Press **[Esc]**

Editing ControlNet I/O Mapping



Follow the steps on the left to go to the ControlNet I/O Mapping (Edit) screen.

Important:

- Only one user on a network can enter a processor's ControlNet I/O Mapping (Edit) screen at one time.
- While you are editing the map-table entries on this screen or accepting pending edits, the screen may display the following message:

  `Maximum transmit size exceeded—adjustments necessary.`

  This indicates that you are attempting to configure a node to transmit more data per NUT than the node can support.

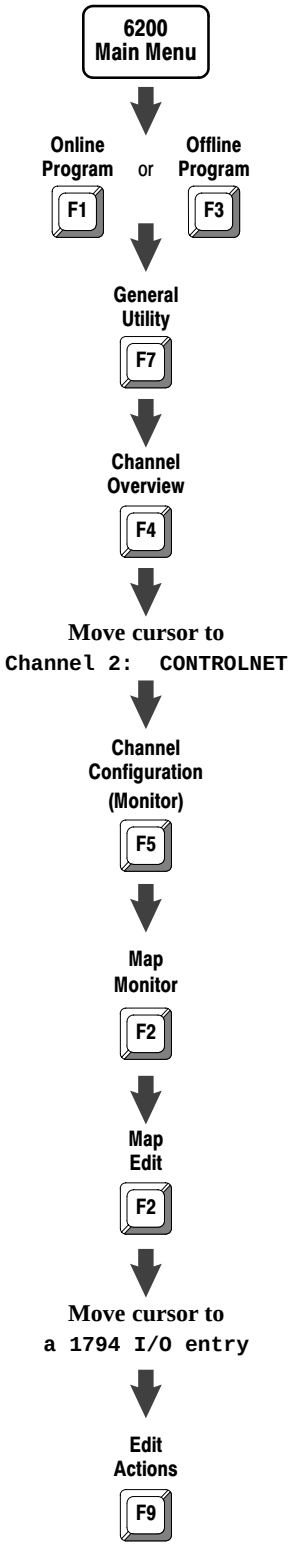
```
                          ControlNet - I/O Mapping                    EDIT
                          Channel 2 Configuration                     NODE 1

Status File:       N32    Network Update Time(ms):  5     Sch BW(%):  64
Data Input File:   N34    ------ Processor's ControlNet Resource Usage ----
Data Output File:  N36    Map Entries     PLC BW (%)     DIF (%)     DOF (%)
Dflt Config File:  N38       8               8            10           8

Node   Mod/Msg Type    Exp Net Pckt  Input       Output     Status     Config
   S/M                   Time(ms) File   Size  File   Size  Offset  File   Size

 1     PLC-5/40C          n/a     n/a     n/a  n/a     n/a          n/a     n/a
   1   Peer Out to 3      20      n/a     n/a  N36:0    24     0    n/a     n/a
 2     1771-ACN            5      I:010     8  O:010     8     3    n/a     n/a
   6   1771-IFE/A         15      N34:0    20  n/a     n/a     6    N38:0    37
   7   1771-OFE/A         13      N34:20    5  N36:64    5     9    N36:64   13
 3     PLC-5/20C          n/a     n/a     n/a  n/a     n/a          n/a     n/a
   1   Peer In             7      N34:25   24  n/a     n/a    15    n/a     n/a

Press a function key, page up or page down, or enter a value.
>
Rem Prog   Forces:None         Display:Slot/Message      5/40C File CN
Accept           Select    Node   Auto   Clear   Insert  Delete   Edit   Select
 Edits           Display   Edit  Mapping   *     to List    *    Actions Option
  F1               F3       F4     F5     F6       F7      F8      F9      F10
```

If you want to:	Do this:
specify and create the status file—the file containing status information on all the ControlNet network's scheduled I/O map-table entries	1. Move the cursor to the **`Status File`** field 2. Type an integer file number between N3 and N999 3. Press **`[Enter]`**
specify and create the DIF—the file used for both non-discrete and peer-to-peer input data transfer over the ControlNet network	1. Move the cursor to the **`Data Input File`** field 2. Type an integer file number between N3 and N999 3. Press **`[Enter]`**
specify and create the DOF—the file used for both non-discrete and peer-to-peer output data transfer over the ControlNet network	1. Move the cursor to the **`Data Output File`** field 2. Type an integer file number between N3 and N999 3. Press **`[Enter]`**
specify and create the Default Configuration File—the file used to store non-discrete I/O data transfer and 1794 Flex I/O configuration information when the automatic-mapping feature is used	1. Move the cursor to the **`Dflt Config File`** field 2. Type an integer file number between N3 and N999 3. Press **`[Enter]`**

If you want to:	Do this:
specify the NUT	1. Move the cursor to the **Network Update Time (ms)** field 2. Type a number between 2 and 100 3. Press **[Enter]**
view the percent of scheduled bandwidth used in the worst case—a percent that changes depending on the NUT and the completed map-table entries	See the **Scheduled Bandwidth Usage** field
view the number of scheduled I/O map-table entries indicating data transfers between the scanning processor and other nodes	See the **Map Entries** field
view the percentage of bandwidth used for the ControlNet PLC-5 processor that you are using	See the **PLC BW (%)** field
view the percentage of the DIF being used	See the **DIF (%)** field
view the percentage of the DOF being used	See the **DOF (%)** field
change a module or message's type	1. Move the cursor to the entry's **Type** field 2. Press **[F10]—Select Option** to toggle to your selection; or enter a unique substring of the name of the new module or message type
change the ENPT for a module or message	1. Move the cursor to the entry's **Exp Net Pckt Time (ms)** field 2. Type a number between the NUT and 15000 3. Press **[Enter]**
manually enter the destination file for information received from a module or message—e.g., a 1771-ACN, 1794-ACN, or Peer In	1. Move the cursor to the entry's **Input File** field If the item is a digital module, "I:" is displayed If it is non-discrete or peer-to-peer input, the DIF is displayed (Scheduled peer-to-peer inputs can also use the input-image file) 2. For non-discrete or peer-to-peer input, type an offset between 0 and 999; for discrete or peer-to-peer input, type an offset between 0 and the end of the input image 3. Press **[Enter]**
manually enter the amount of information received from a module or message—e.g., a 1771-ACN, 1794-ACN, or Peer In	1. Move the cursor to the entry's **Input Size** field 2. Type a value 3. Press **[Enter]**
manually enter the source file for information sent to a module or in a message—e.g., a 1771-ACN, 1794-ACN, or Peer Out	1. Move the cursor to the entry's **Output File** field If the item is a digital module, "O:" is displayed If it is non-discrete or peer-to-peer output, the DOF is displayed (Scheduled peer-to-peer outputs can also use the output-image file) 2. For non-discrete or peer-to-peer output, type an offset between 0 and 999; for discrete or peer-to-peer output, type an offset between 0 and the end of the output image 3. Press **[Enter]**
manually enter the amount of information sent to a module or in a message—e.g., a 1771-ACN, 1794-ACN, or Peer Out	1. Move the cursor to the entry's **Output Size** field 2. Type a value 3. Press **[Enter]**

If you want to:	Do this:
view the offset into the status file that contains the status information for a module or message (determined by the software)	See the **Status Offset** field for the item
manually enter the file for storing the I/O configuration needed for a module—e.g., a 1771-IFE or 1794-ACN **Important:** If a 1771 module uses the DOF, this must match.	1. Move the cursor to the module's **Config File** field 2. Type an integer file number between N3 and N999 3. Press **[Enter]**
manually enter the amount of information to be stored in the I/O configuration file for a module—e.g., a 1771-IFE	1. Move the cursor to the module's **Config Size** field 2. Type a valid value 3. Press **[Enter]**
select the display of slots, messages, or slots and messages in the list **Slot Display** displays all the non-digital I/O cards configured in physical slots of a chassis and their physical slot numbers **Message Display** displays all the peer-to-peer messages configured between PLC processors and their message numbers **Slot/Message** displays all the above	1. Press **[F3]—Select Display** 2. Press **[F2]—Slot Display** or **[F3]—Message Display** or **[F4]—Slot/Message**
go to the ControlNet Node Information (Edit) screen	Press **[F4]—Node Edit**
have the software automatically map—into available data-table space (I/O or DIF/DOF)—modules and messages that are listed but not mapped	1. Press **[F5]—Auto Mapping** 2. Select items to be mapped by pressing: • **[F2]—Select All** to select all the items that are not mapped • **[F3]—Toggle** to select or unselect an item that is highlighted by the cursor • **[F4]—Clear All** to unselect any items that are selected • **[F8]—Auto Module** to have the software automatically scan configured nodes for slot information if you are programming online For 1771 I/O, **Auto Module** determines the size of the chassis For 1794 Flex I/O, **Auto Module** determines the size of the chassis and lists all the non-discrete I/O data-transfer modules in the chassis 3. Press **[F10]—Auto I/O Map**
clear the following information on a module or message: • input file and offset • output file and offset • status offset • config file and offset	1. Move the cursor to the slot/message where you want to clear information 2. Press **[F6]—Clear *** 3. Press **[F8]—Clear Item**
clear the following information about all modules and messages: • input file and offset • output file and offset • status offset • config file and offset	1. Press **[F6]—Clear *** 2. Press **[F10]—Clear List**

If you want to:	Do this:
insert an entry or range of entries into the list	**1.** Move the cursor to the node where you want to add a module or message **2.** Press **[F7]—Insert to List** **3.** Type the slot or message number (*slot/message* or *node.slot/message*) for a single new entry or range (*slot/message-slot/message* or *node.slot/message-slot/message*) for multiple new entries **4.** Press **[Enter]**
delete a module or message	**1.** Move the cursor to the item that you want to delete **2.** Press **[F8]—Delete *** **3.** Press **[F8]—Delete Item**
delete all modules and messages	**1.** Press **[F8]—Delete *** **2.** Press **[F10]—Delete List**
go to the ControlNet I/O Action screen **Important:** This option is not available if the display mode is set to **Message Display** on this screen by using **[F3]—Select Display**.	**1.** Move the cursor to the 1794 Flex I/O module entry who's actions you want to edit **2.** Press **[F9]—Edit Actions**
apply pending edits and return to the ControlNet I/O Mapping (Monitor) screen	Press **[F1]—Accept Edits**
return to the ControlNet I/O Mapping (Monitor) screen without saving any pending edits	Press **[Esc]**



Editing ControlNet 1794 I/O Module Action

Follow the steps on the left to the ControlNet I/O Action (Edit) screen.

Important: Only one user on a network can enter a processor's ControlNet 1794 I/O Module Action screen at one time.

```
                          ControlNet – I/O Action                    EDIT
                          Channel 2 Configuration                    NODE  1

Node  4 1794-ACN

   Module Type        Fault Action         Idle Action        Fault Action
Slot                                                          From Idle

 0 1794-Digital     Reset                Reset                Idle
 1 1794-IE8/A       Reset                Reset                Idle
 2 1794-OE4/A       Safe                 Reset                Idle
 3 1794-IE4XOE2/A   Safe                 Reset                Idle
 4 1794-Digital     Reset                Reset                Idle
 5 1794-Digital     Reset                Reset                Idle
 6 1794-Digital     Reset                Reset                Idle
 7 1794-Digital     Reset                Reset                Idle


Press a function key or cursor key.
>
Rem Prog   Forces:None                                  5/40C File CN
Accept    Map                                        Toggle          Toggle
 Edits   Edit                                          All             Entry
  F1      F2                                           F8              F10
```

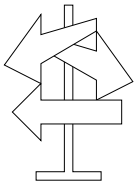
If you want to:	Do this:
change a system's fault action —i.e., the action that it takes when it faults	**1.** Move the cursor to the **`Fault Action`** column **2.** Press **`[F8]–Toggle All`** to toggle between: • **`Reset`**—to change all outputs to zero • **`Hold Last`**—to maintain all current output values • **`Safe`**—to change all outputs to user-specified fail–safe values
change a system's idle action —i.e., the action that it takes when it becomes idle	**1.** Move the cursor to the **`Idle Action`** column **2.** Press **`[F8]–Toggle All`** to toggle between: • **`Reset`**—to change all outputs to zero • **`Hold Last`**—to maintain all current output values • **`Safe`**—to change all outputs to user-specified fail–safe values
change a system's fault action from idle—i.e., the action that it takes when it faults from idle	**1.** Move the cursor to the **`Fault Action From Idle`** column **2.** Press **`[F8]–Toggle All`** to toggle between: • **`Idle`**—to use the idle action • **`Fault`**—to use the fault action
change a module's fault action —i.e., the action that it takes when it faults	**1.** Move the cursor to the module's field **`Fault Action`** field **2.** Press **`[F10]–Toggle Entry`** to toggle between: • **`Reset`**—to change all outputs to zero • **`Hold Last`**—to maintain all current output values • **`Safe`**—to change all outputs to user-specified fail–safe values

If you want to:	Do this:
change a module's idle action —i.e., the action that it takes when it becomes idle	**1.** Move the cursor to the module's **`Idle Action`** field **2.** Press **`[F10]—Toggle Entry`** to toggle between: • **`Reset`**—to change all outputs to zero • **`Hold Last`**—to maintain all current output values • **`Safe`**—to change all outputs to user-specified fail–safe values
change a module's fault action from idle—i.e., the action that it takes when it faults from idle	**1.** Move the cursor to the module's **`Fault Action From Idle`** field **2.** Press **`[F10]—Toggle Entry`** to toggle between: • **`Idle`**—to use the idle action • **`Fault`**—to use the fault action
apply pending edits and return to the ControlNet I/O Mapping (Edit) screen	Press **`[F1]—Accept Edits`**
go back to the ControlNet I/O Mapping (Edit) screen	Press **`[F2]—Map Edit`** or **`[Esc]`**

Chapter 4

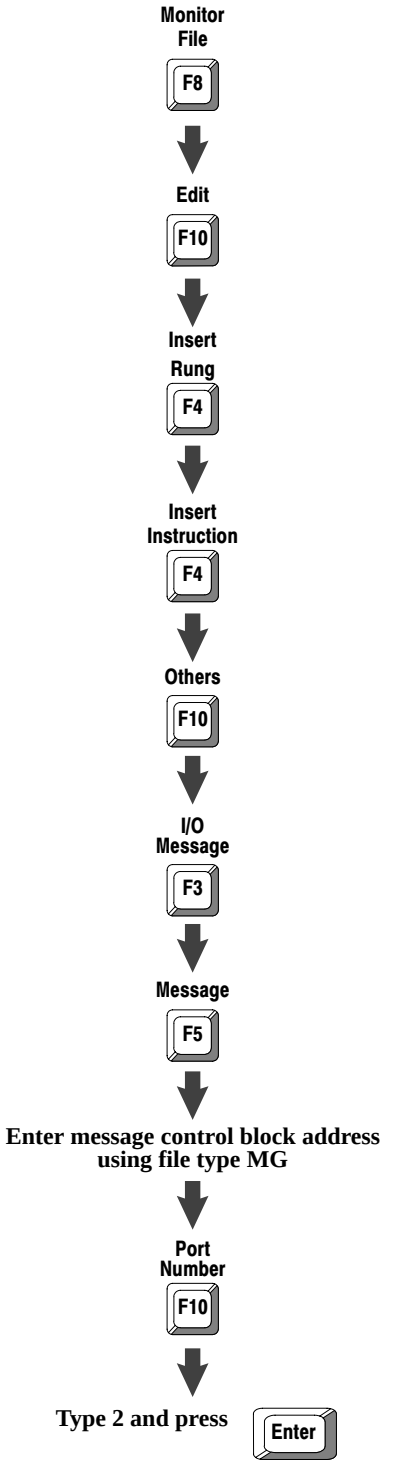
Programming Your ControlNet System

Using This Chapter



If you want to read about using:	Go to page:
ControlNet message instructions	4-2
ControlNet I/O transfer instructions	4-4
ControlNet immediate data input and output instructions	4-6
Using Selectable Timed Interrupts (STIs) in a program on a ControlNet network	4-7

Using ControlNet Message Instructions

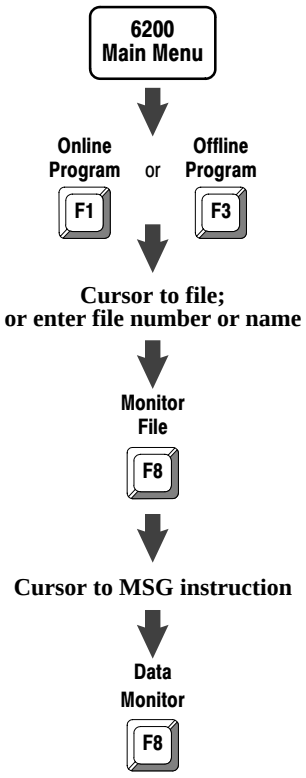


You can use the existing MG data type to send two message commands over the ControlNet system within the local ControlNet link—PLC-5 TYPED WRITE and PLC-5 TYPED READ.

Follow the steps on the left to go to the Instruction Entry for Message Block screen.

```
                Instruction Entry for Message Block MG20:50

              Communication Command:             PLC-5 TYPED WRITE
              PLC-5 Data Table Address:          N8:0
              Size in Elements:                  1




              Local ControlNet Node:             1
              Destination Data Table Address:    N11:0
              Port Number:                       2

  BLOCK SIZE = 56 WORDS


Press a key to change a parameter or <ENTER> to accept parameters.
>
Rem Prog   Forces:None      Edits:None                  5/40C File CN
Command  PLC-5  Size in                               Local   Destin   Port
 Type   Address Elemnts                                Node   Address Number
  F1      F2      F3                                    F8      F9      F10
```

If you want to:	Do this:
change the command type	Press **[F1]—Command Type** to toggle between: • **PLC-5 TYPED WRITE**—to select a write operation to another PLC-5 processor • **PLC-5 TYPED READ**—to select a read operation from another PLC-5 processor
enter a PLC-5 data-table address	**1.** Press **[F2]—PLC-5 Address** **2.** Type the PLC-5 data-table address **3.** Press **[Enter]**
enter the size in elements	**1.** Press **[F3]—Size in Elemnts** **2.** Type a number of elements from 1 to 1000 **3.** Press **[Enter]**
enter the destination network address	**1.** Press **[F8]—Local Node** **2.** Type a number from 1 to 99 **3.** Press **[Enter]**
enter a destination data-table address	**1.** Press **[F9]—Destin Address** **2.** Type the destination data-table address **3.** Press **[Enter]**

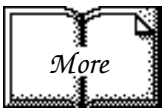


Follow the steps on the left to go to the Data Monitor for Message Control Block screen.

```
                Data Monitor for Message Control Block MG20:50

 Communication Command:           PLC-5 TYPED WRITE
 PLC-5 Data Table Address:        N8:0              ignore if timed-out:  0 TO
 Size in Elements:                1                      to be retried:  0 NR
                                                  awaiting execution:  0 EW
                                                           continuous:  0 CO
                                                                error:  0 ER
                                                         message done:  0 DN
 Local ControlNet Node:           1                message transmitting:  0 ST
 Destination Data Table Address:  N11:0                 message enabled:  0 EN
 Port Number:                     2

 Error Code: 0000 (HEX)


Press a function key or enter a value.
MG20:50.TO =
Rem Prog   Forces:None      Data:Decimal   Addr:Decimal  5/40C File CN
        Toggle  Size in         Specify          Next    Prev    Next    Prev
          Bit   Elemnts         Address          File    File   Element Element
          F2      F3              F5             F7      F8      F9      F10
```

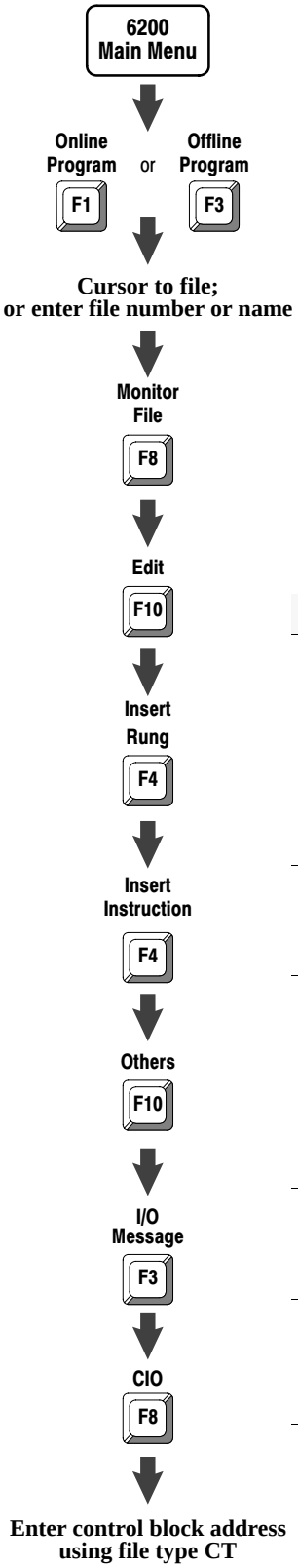
The fields of the MG data type that you can directly address are:

.TO	Abort (Time out) control bit	word 0, bit 08
.NR	No-response flag bit—not used	word 0, bit 09
.EW	Enabled-waiting flag bit	word 0, bit 02
.CO	Continuous control bit	word 0, bit 03
.ER	Errored flag bit	word 0, bit 04
.DN	Done flag bit	word 0, bit 05
.ST	Started flag bit	word 0, bit 06
.EN	Enabled flag bit	word 0, bit 07
.ERR	Error-code word	word 1
.RLEN	Requested length word	word 2



For more detailed information on writing ladder programs and using message instructions, see the PLC-5 Programming Software Instruction Set Reference, publication 6200-6.4.11, and PLC-5 Programming Software Programming, publication 6200-6.4.7.

Using the ControlNet I/O Transfer Instruction

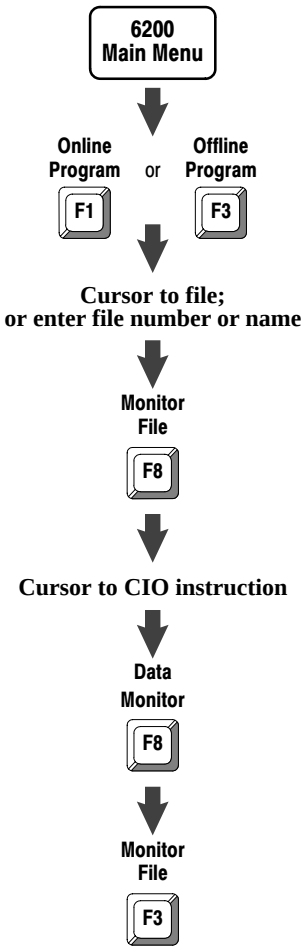


You can use the ControlNet I/O Transfer (CIO) instruction and the ControlNet Transfer (CT) data type to make ControlNet I/O transfers within the local ControlNet link. Follow the steps on the left to go to the Instruction Entry for ControlNet I/O Transfer Block screen.

```
        Instruction Entry for ControlNet I/O Transfer Block CT21:50

             Communication Command:            1771 WRITE
             PLC-5 Data Table Address:         N7:3
             Size in Elements:                 10
             Elements Transmitted:             0



             Local ControlNet Node:            1
             Slot Number:                      0
             Port Number:                      2

  BLOCK SIZE = 22 WORDS


Press a key to change a parameter or <ENTER> to accept parameters.
>
Rem Prog   Forces:None      Edits:None                  5/40C File CN
Command  PLC-5  Size in                                Local    Slot
 Type   Address Elemnts                                 Node   Number
  F1      F2      F3                                     F8      F9
```

If you want to:	Do this:
change the command type	Press **[F1]—Command Type** to toggle between: • **1771 READ**—reads input data from 1771 non-discrete I/O module • **1771 WRITE**—writes output data to 1771 non-discrete I/O module • **1794 FAULT ACTION**—changes the action that a module takes when it faults • **1794 IDLE ACTION**—changes the action that a module takes when it is idle • **1794 CONFIG DATA**—changes a module's configuration data • **1794 SAFE STATE DATA**—changes a module's safe-state data
enter a PLC-5 data-table address	**1.** Press **[F2]—PLC-5 Address** **2.** Type the data-table address **3.** Press **[Enter]**
enter the size in elements	**1.** Press **[F3]—Size in Elemnts** **2.** Type the number of elements: • **1** for **1794 FAULT ACTION** or **1794 IDLE ACTION** • **1** to **15** for **1794 CONFIG DATA** or **1794 SAFE STATE DATA** • **0**[1] to **64** for **1771 READ** or **1771 WRITE** **3.** Press **[Enter]**
enter the destination network address	**1.** Press **[F8]—Local Node** **2.** Type a number from 1 to 99 **3.** Press **[Enter]**
enter the destination slot number	**1.** Press **[F9]—Slot Number** **2.** Type the number of the slot that holds the I/O device—number from 0 to 15 **3.** Press **[Enter]**

[1] If you enter a **0**, the module determines the size of the transfer. In this case, you must make sure that your data-table can accomodate up to 64 words.

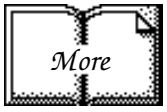


Follow the steps on the left to go to the Data Monitor for ControlNet I/O Transfer Block screen.

```
            Data Monitor for ControlNet I/O Transfer Block CT21:50

 Communication Command:          1771 Write
 PLC-5 Data Table Address:       N7:3              ignore if timed-out:  0 TO
 Size in Elements:               10                 awaiting execution:  0 EW
 Elements Transmitted:           0                          continuous:  0 CO
                                                               error:  0 ER
                                                          transfer done:  0 DN
 Local ControlNet Node:          1                   transfer started:  0 ST
 Slot Number:                    0                   transfer enabled:  0 EN
 Port Number:                    2

 Error Code: 0000 (HEX)



Press a function key or enter a value.
CT21:50.TO =
Rem Prog   Forces:None      Data:Decimal   Addr:Decimal  5/40C File CN
        Toggle  Size in         Specify          Next    Prev    Next    Prev
          Bit   Elemnts         Address          File    File   Element Element
          F2      F3              F5             F7      F8      F9      F10
```

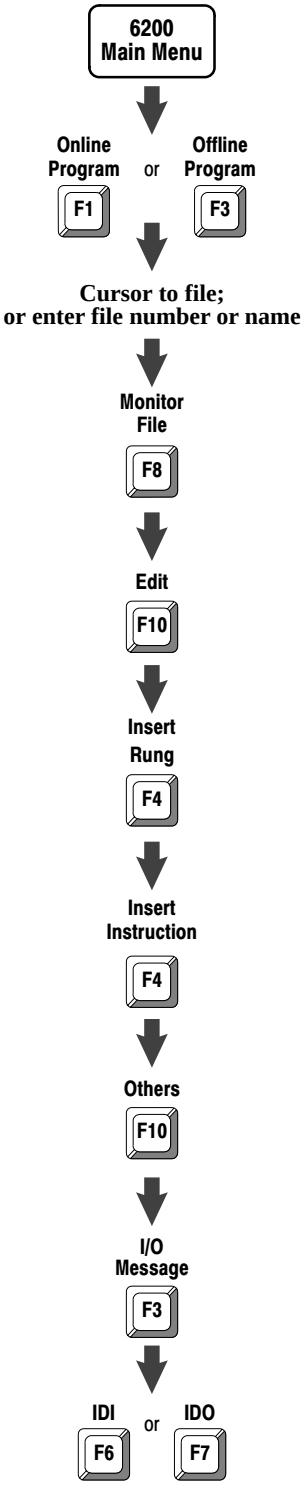
The fields of the CT data type that you can directly address are:

.TO	Abort (Time out) control bit	word 0, bit 08
.EW	Enabled-waiting flag bit	word 0, bit 02
.CO	Continuous control bit	word 0, bit 03
.ER	Errored flag bit	word 0, bit 04
.DN	Done flag bit	word 0, bit 05
.ST	Started flag bit	word 0, bit 06
.EN	Enabled flag bit	word 0, bit 07
.ERR	Error-code word	word 1
.RLEN	Requested length word	word 2
.DLEN	Done length word	word 3
.FILE	Transfer file number	word 4
.ELEM	Transfer element number	word 5



For more detailed information on writing ladder programs, see the PLC-5 Programming Software Instruction Set Reference, publication 6200-6.4.11, and PLC-5 Programming Software Programming, publication 6200-6.4.7.

Using ControlNet Immediate Data Input and Output Instructions



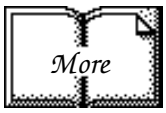
You can use two instructions for immediate data input and output on a ControlNet network—Immediate Data Input (IDI) and Immediate Data Output (IDO).

Follow the steps on the left to add IDI and IDO instructions to your program.

```
                                    IDI
                                    IMMEDIATE DATA INPUT
                                    Data file offset        232

                                    Length                   10

                                    Destination         N11:232

                                    IDO
                                    IMMEDIATE DATA OUTPUT
                                    Data file offset        175

                                    Length                   24

                                    Source              N12:175

                        [END OF FILE]

Press a function key.
(File 2: Rung 0)
Rem Prog   Forces:None      Edits:None                    5/40C File CN
Change  Config  Return  Program Documnt Search  General  Data    Force   Edit
 Mode   Display to Menu Dirctry                 Utility Monitor
  F1      F2      F3      F4      F5      F6      F7      F8      F9      F10
```

In the example above, an IDI is initiated that updates the destination file from the private buffer before the next normal input-image update. The Data File Offset (232) is the offset into the buffer where the data is stored. The Length (10) identifies the number of words in the transfer—it can be an immediate value ranging from 1 to 64 or a logical address that specifies the number of words to be transferred. The Destination (N11:232) is the destination of the words to be transferred. The Destination should be the matching data-table address in the DIF except when you use the instruction to ensure data-block integrity in the case of Selectable Timed Interrupts (STIs). See page 4-7.

An IDO is initiated that updates the private memory output buffer from the source file before the next normal output- image update. The Data File Offset (175) is the offset into the buffer where the data is stored. The Length (24) identifies the number of words in the transfer or a logical address that specifies the number of words to be transferred. The Source (N12:175) is the source of the words to be transferred. The Source should be the matching data-table address in the DOF except when you use the instruction to ensure data-block integrity in the case of Selectable Timed Interrupts (STIs). See page 4-7.



For more detailed information on writing ladder programs, see the PLC-5 Programming Software Instruction Set Reference, publication 6200-6.4.11, and PLC-5 Programming Software Programming, publication 6200-6.4.7.

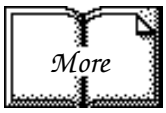
For information on programming ControlNet I/O transfers using Immediate Input (INN) and Immediate Output (IOT) instructions, see the PLC-5 Programming Software Instruction Set Reference, publication 6200-6.4.11.

Using Selectable Timed Interrupts with a Program on a ControlNet Network

You must be careful when using Selectable Timed Interrupts (STIs) with a program on a ControlNet network.

A Selectable Timed Interrupt (STI) periodically interrupts primary program execution in order to run a subprogram to completion. If an STI occurs while a normal ControlNet non-discrete I/O data transfer or a ControlNet Immediate Data I/O instruction (IDO or IDI) is in progress and they both operate on the same set of data, the integrity of that block of data is jeopardized.

To ensure data-block integrity, write your STI routine so that it operates on its own copy of the data block that it needs. Use ControlNet Immediate Data I/O instructions (IDO and IDI) within your STI to copy the needed block of data out to and back from a temporary location that is different from that used by the normal data table.

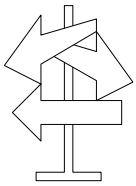


For detailed information on STIs, see PLC-5 Programming Software Configuration and Maintenance, publication 6200-6.4.6.

Chapter 5

Monitoring and Troubleshooting Your ControlNet System

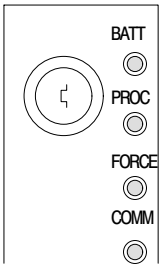
Using This Chapter



If you want to read about:	See page:
Using the general status indicators	5-2
Using the ControlNet status indicators	5-3
Monitoring the ControlNet configuration and status screens	5-5

Using the General Status Indicators

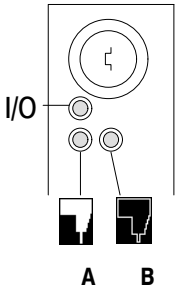
The general status indicators inform you of the general operational state of the processor.



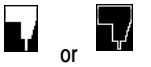
Indicator	State	Description	Probable Cause(s)	Recommended Action(s)
BATT	Steady Red	Battery low	Battery low	Replace battery within 10 days (typical)
	Off	Battery good	Normal operation	None
PROC	Steady Green	Processor in Run mode and fully operational	Normal operation	None
	Flashing Green	Processor memory being transferred to EEPROM		
	Flashing Red	Major fault	Run-time error	**1.** Check major fault bit in status file (S:11) for error definition **2.** Clear fault bit **3.** Correct problem **4.** Return to Run mode
	Alternating Red and Green	Processor in FLASH-memory programming mode	Normal operation if processor's FLASH memory is being reprogrammed	None
			Processor FLASH memory checksum error	Contact your local A-B representative for a field firmware update
	Steady Red	Major fault	Processor memory checksum error	Clear memory and reload program
			Memory-module error	Correct backplane switch settings, and/or insert correct memory module
			Internal diagnostics failed	**1.** Turn power off, reseat processor, then power up **2.** Clear memory and reload your program **3.** Replace EEPROM with new program **4.** If still an error, replace the processor
	Off	Processor in Program Load or Test mode	Normal operation if mode correct	None
FORCE	Steady Amber	SFC and/or I/O forces enabled	Normal operation	None
	Flashing Amber	SFC and/or I/O forces present but not enabled		
	Off	SFC and/or I/O forces not present		
COMM	Off	No transmission on Channel 0	Normal operation if channel not being used	
	Flashing Green	Transmission on Channel 0	Normal operation if channel being used	

Using the ControlNet Status Indicators

The ControlNet status indicators inform you of the operational state of the ControlNet network.



Indicator	State	Description	Probable Cause(s)	Recommended Action(s)
I/O	Off	ControlNet I/O not present or not operating	Normal operation if Channel 2 not being used	None
	Steady Green	All nodes configured in the ControlNet map table present and operating properly	Normal operation	None
	Flashing Green/Off	At least one node configured for the ControlNet network not present or not operating properly	Cable(s) or connector(s) broken or not connected	Repair or replace cable(s) or connector(s), and reconnect
			Destination module(s) bad or missing	Repair or replace module(s)
			Node(s) not on network	Connect node to network
	Flashing Red/Off	All nodes configured for ControlNet not present or not operating properly	Cable(s) or connector(s) broken or not connected	Repair or replace cable(s) or connector(s), and reconnect
			Nodes not on network	Connect nodes to network

Indicator	State[1]	Probable Cause	Recommended Action(s)
A and B	Off	No power	None
			Power up
	Steady Red	Faulted unit	Cycle power or reset unit
			If fault persists, contact your Allen-Bradley Company, Inc. representative or distributor
	Alternating Red/Green	Self-test	None
	Alternating Red/Off	Incorrect node configuration	Check network address and other ControlNet configuration parameters
 A or B	Off	Channel disabled	None
			Configure for ControlNet communication
	Steady Green	Normal operation	None
	Flashing Green/Off	Temporary errors	None
			Make sure that ControlNet is properly terminated
		Node is not configured to go online	Make sure the Configuration Manager node is present and working[2]
	Flashing Red/Off	Media fault	Check media for broken cables, loose connectors, missing terminators, etc.
		No other nodes present on network	Add other nodes to the network
	Flashing Red/Green	Incorrect network configuration	Cycle power or reset unit
			If fault persists, contact your Allen-Bradley Company, Inc. representative or distributor

[1] Definition of terms:

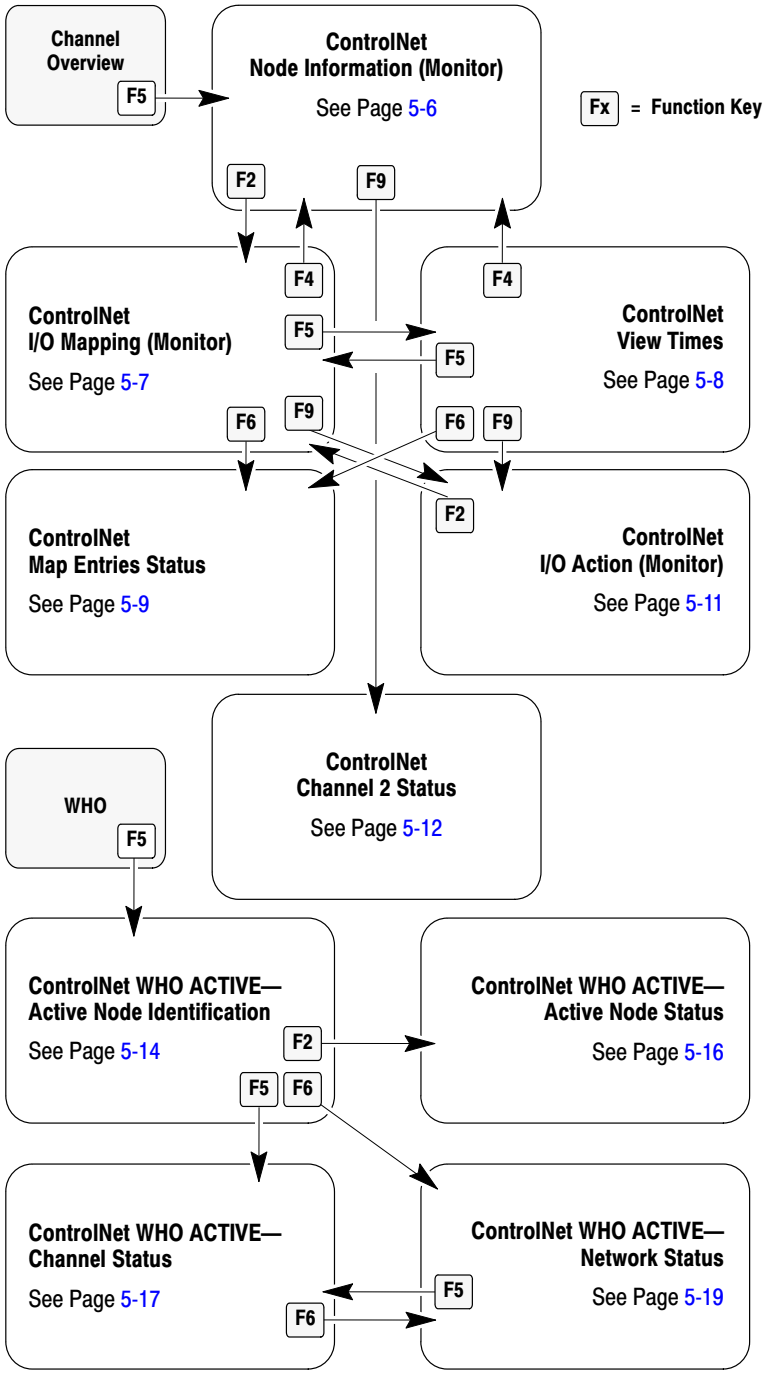
- **alternating**—the two indicators alternate between the two defined states at the same time (applies to both indicators *viewed together*); the two indicators are always in opposite states, out of phase
- **flashing**—the indicator alternates between the two defined states (applies to each indicator *viewed independent* of the other); if both indicators are flashing, they flash together, in phase
- **steady**—indicator is on continuously in the defined state

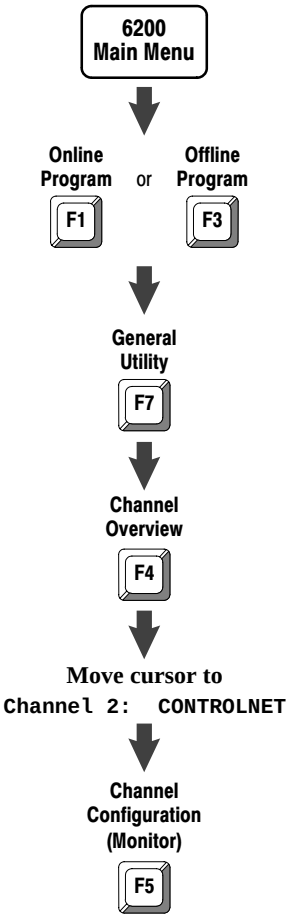
[2] The Configuration Manager node—at node 01, the controlling processor— is the node responsible for distributing ControlNet configuration data to all nodes on the ControlNet network.

Using the 6200 Programming Software to Monitor ControlNet Configuration and Status

This section shows you how to use the ControlNet configuration monitor and status screens found in the 6200 PLC-5 Programming Software, release 5.1 or later.

ControlNet Configuration Monitor and Status Screens in the 6200 Programming Software





Using the ControlNet Node Information (Monitor) Screen

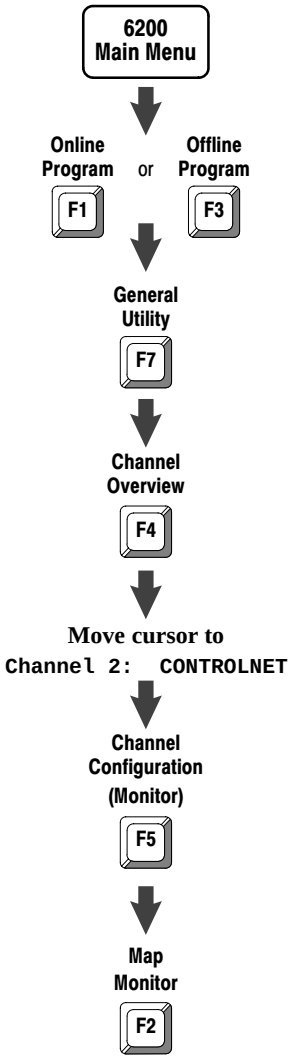
Follow the steps on the left to go to the ControlNet Node Information (Monitor) screen.

```
                        ControlNet - Node Information                MONITOR
                           Channel 2 Configuration                   NODE  1

Diagnostics File:             N12        Network Update Time(ms):        5
Coax Repeaters in Series:       1        Scheduled Bandwidth Usage:    64%
Fiber Repeater Pairs:           0        Media Redundancy Usage:    A Only
                                         Maximum Scheduled Node:        10


Node  Node Type       Series/Revision     Status

  1   PLC-5/40C             C/H           ACTIVE
  2   1771-ACN              A/A           ACTIVE
  3   PLC-5/20C             C/H           ACTIVE
  4   1794-ACN              A/A           ACTIVE



Press a function key, page up or page down, or enter a node. number.
>
Rem Prog   Forces:None                                    5/40C File CN
          Map              Node                 Define          Chan 2
        Monitor            Edit                 LclRack         Status
          F2                F4                   F7              F9
```

The ControlNet Node Information (Monitor) screen lists the nodes that you have entered for the ControlNet network; and it shows the node type, product series/revision, and status (active or inactive) that you have configured for each node.

If you want to:	Press:
quickly position the cursor on a specific node in the list	**1.** Type the node number and a period (.)—e.g., **`2.`** **2.** Press **`[Enter]`**
go to the ControlNet I/O Mapping (Monitor) screen	Press **`[F2]—Map Monitor`**
go to the ControlNet Node Information (Edit) screen	Press **`[F4]—Node Edit`**
define the characteristics of the local chassis (for reserving I/O image space) **Important:** This option is not available if you are programming online.	Press **`[F7]—Define LclRack`**
go to the ControlNet Channel 2 Status screen	Press **`[F9]—Chan 2 Status`**
go to the Channel Overview screen	Press **`[Esc]`**

Using the ControlNet I/O Mapping (Monitor) Screen

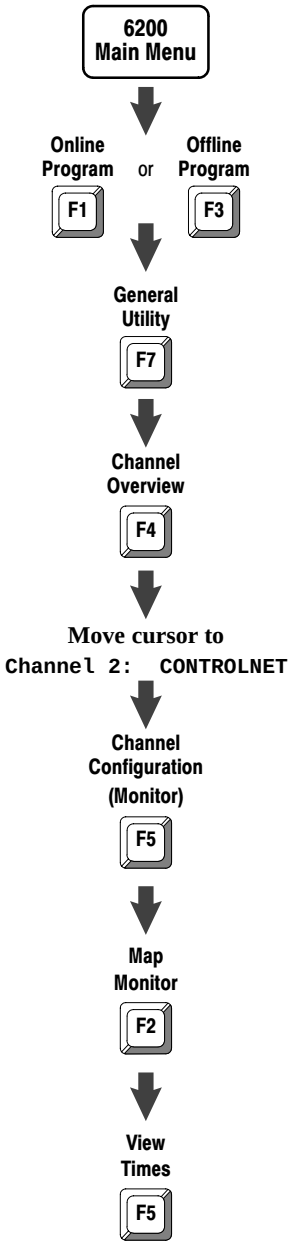


Follow the steps on the left to go to the ControlNet I/O Mapping (Monitor) screen.

```
                          ControlNet – I/O Mapping                    MONITOR
                          Channel 2 Configuration                     NODE  1

Status File:       N32       Network Update Time(ms):  5     Sch BW(%):  64
Data Input File:   N34       ------ Processor's ControlNet Resource Usage -----
Data Output File:  N36       Map Entries     PLC BW (%)     DIF (%)     DOF (%)
Dflt Config File:  N38           8              8              10          8

Node   Mod/Msg Type   Act Net Pckt    Input      Output     Status    Config
  S/M                   Time(ms)  File   Size  File   Size  Offset  File   Size

 1     PLC-5/40C          n/a      n/a     n/a  n/a     n/a           n/a     n/a
   1   Peer Out to 3     20        n/a     n/a  N36:0    64     0     n/a     n/a
 2     1771-ACN           5        I:010     8  O:010     8     3     n/a     n/a
   6   1771-IFE/A        10        N34:0    20  n/a     n/a     6     N38:0    37
   7   1771-OFE/A        10        N34:20    5  N36:64    5     9     N36:64   13
 3     PLC-5/20C          n/a      n/a     n/a  n/a     n/a           n/a     n/a
   1   Peer In            5        N34:25   24  n/a     n/a    15     n/a     n/a

Press a function key, page up or page down, or enter a node.s/m number.
>
Rem Prog   Forces:None          Display:Slot/Message      5/40C File  CN
          Map   Select   Node    View   Monitor  Define   I/O   Monitor
         Edit   Display Monitor  Times  Status  LclRack Monitor Actions
          F2      F3      F4      F5      F6      F7      F8      F9
```

If you want to:	Do this:
quickly position the cursor on a specific entry in the list	**1.** Type the node number, a period (.), and the slot or message number of the entry—e.g., **`2.7`** **2.** Press **`[Enter]`**
go to the ControlNet I/O Mapping (Edit) screen	Press **`[F2]—Map Edit`**
select the display of slots, messages, or slots and messages in the list	**1.** Press **`[F3]—Select Display`** **2.** Press **`[F2]—Slot Display`** or **`[F3]—Message Display`** or **`[F4]—Slot/Message`**
go to the ControlNet Node Information (Monitor) screen	Press **`[F4]—Node Monitor`**
view the Actual Network Packet Time (ANPT) and Expected Network Packet Time (ENPT) instead of the input, output, status, and configuration information	Press **`[F5]—View Times`**
go to the ControlNet Map Entries Status screen	Press **`[F6]—Monitor Status`**
define the characteristics of the local chassis **Important:** This option is not available if you are programming online.	Press **`[F7]—Define LclRack`**
go to the I/O Configuration Monitor Utility	**1.** Move your cursor to an analog entry **2.** Press **`[F8]—I/O Monitor`**
go to the ControlNet I/O Action (Monitor) screen **Important:** This option is not available if the display mode is set to **`Message Display`** on this screen or the ControlNet View Times screen by using **`[F3]—Select Display`**.	**1.** Move the cursor to the 1794 I/O module entry who's actions you want to monitor **2.** Press **`[F9]—Monitor Actions`**
return to the ControlNet Node Information (Monitor) screen	Press **`[Esc]`**

Using the ControlNet View Times Screen

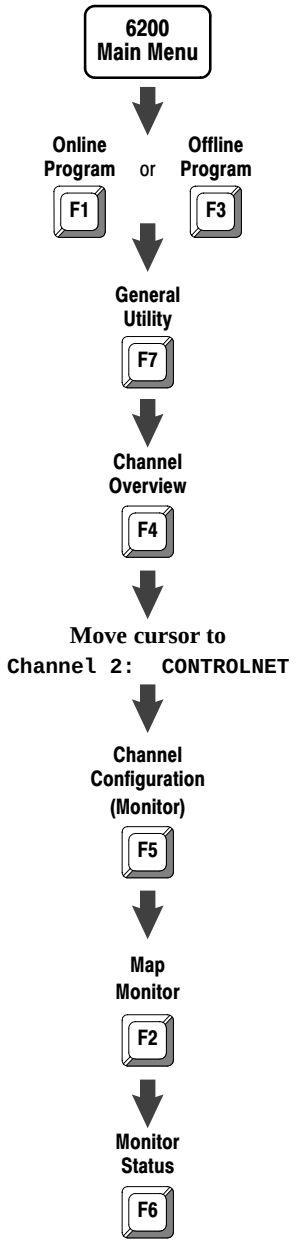


Follow the steps on the left to go to the ControlNet View Times screen.

```
                          ControlNet – View Times                    MONITOR
                          Channel 2 Configuration                    NODE  1

Status File:       N32       Network Update Time(ms):  5     Sch BW(%): 64
Data Input File:   N34       ------ Processor's ControlNet Resource Usage -----
Data Output File:  N36       Map Entries     PLC BW (%)     DIF (%)     DOF (%)
Dflt Config File:  N38           8             8              10          8

Node   Mod/Msg Type   Act Net Pckt Exp Net Pckt
  S/M                   Time(ms)     Time(ms)

 1     PLC-5/20C           n/a          n/a
   1   Peer Out To  3       20           20
 2     1771-ACN              5            5
   6   1771-IFE/A           10           15
   7   1771-OFE/A           10           13
 3     PLC-5/20C           n/a          n/a
   1   Peer In               5            7

Press a function key, page up or page down, or enter a node.s/m number.
>
Rem Prog   Forces:None         Display:Slot/Message      5/40C File CN
          Map   Select   Node    View   Monitor           I/O   Monitor
         Edit   Display Monitor Mapping Status          Monitor Actions
          F2      F3      F4      F5      F6             F8      F9
```

If you want to:	Do this:
quickly position the cursor on a specific entry in the list	**1.** Type the node number, a period (.), and the slot or message number of the entry **2.** Press **[Enter]**
see the ANPT for an entry—the actual time it takes for the network to update the data	Look at the **Act Net Pckt Time (ms)** field for that entry
see the ENPT for an entry—the maximum time allowed for the network to update the data	Look at the **Exp Net Pckt Time (ms)** field for that entry
go to the ControlNet I/O Mapping (Edit) screen	Press **[F2]—Map Edit**
select the display of slots, messages, or slots and messages in the list	**1.** Press **[F3]—Select Display** **2.** Press **[F2]—Slot Display** or **[F3]—Message Display** or **[F4]—Slot/Message**
go to the ControlNet Node Information (Monitor) screen	Press **[F4]—Node Monitor**
toggle back to view input, output, status, and configuration information	Press **[F5]-View Mapping**
go to the ControlNet Map Entries Status screen	Press **[F6]—Monitor Status**
go to the I/O Configuration Monitor Utility	**1.** Move your cursor to an analog entry **2.** Press **[F8]—I/O Monitor**
go to the ControlNet I/O Action (Monitor) screen **Important:** This option is not available if the display mode is set to **Message Display** on this screen or the ControlNet I/O Mapping screen by using **[F3]—Select Display**.	**1.** Move the cursor to the 1794 I/O module entry who's actions you want to monitor **2.** Press **[F9]—Monitor Actions**
return to the ControlNet Node Information (Monitor) screen	Press **[Esc]**

Using the ControlNet Map Entries Status Screen



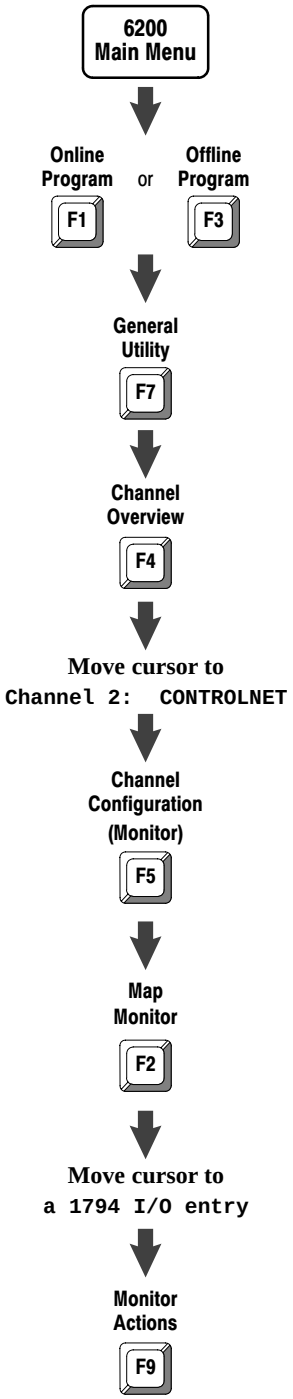
Follow the steps on the left to go to the ControlNet Map Entries Status screen.

```
                    ControlNet – Map Entries Status              MONITOR
                        Channel 2 Configuration

Status File:       N32       Network Update Time(ms):  5     Sch BW(%):  64
Data Input File:   N34       ------ Processor's ControlNet Resource Usage -----
Data Output File:  N36       Map Entries     PLC BW (%)     DIF (%)     DOF (%)
Dflt Config File:  N38           8             8              10          8

Node    Mod/Msg Type     Status                       Status  Data  Inhibit
  S/M                                                Offset  Valid       Reset

 1      PLC-5/40C        n/a                                 n/a      n/a  n/a
   1  W Peer Out to 3    SUCCESS                        0    YES       0    0
 2      1771-ACN         SUCCESS                        3    YES       0    0
   6  R 1771-IFE/A       SUCCESS                        6    YES       0    0
   7  R 1771-OFE/A       SUCCESS                        9    YES       0    0
   7  W 1771-OFE/A       SUCCESS                       12    YES       0    0
 3      PLC-5/20C        n/a                                 n/a      n/a  n/a

Page up or page down, or enter a value.
>
Rem Prog   Forces:None         Display:Slot/Message      5/40C File CN
                Select
                Display
                  F3
```

If you want to:	Do this:
select the display of slots, messages, or slots and messages in the list	1. Press **[F3]—Select Display** 2. Press **[F2]—Slot Display** or **[F3]—Message Display** or **[F4]—Slot/Message**
see whether an entry is a Read (R) or Write (W) operation	Look at the field to the right of the **S/M** field for that entry
view the current status of an entry	Look at the **Status** field for that entry See Appendix D for a list of errors that may be displayed
see where the three status words associated with an entry are located in the Status File	Look at the **Status Offset** field for that entry
see whether the data associated with an entry is valid or invalid	Look at the **Data Valid** field for that entry For all I/O modules except 1794: • **YES**—indicates that the status data for the slot are valid • **NO**—indicates that the status data for the slot are not valid For all 1794 I/O modules: • **Y**—indicates that the status data for the slot are valid • **N**—indicates that the status data for the slot are not valid • **X**—indicates that the slot is not configured For example, a 1794 I/O module field of **YYXNNXYX** indicates: • the status data for slots 0, 1, and 6 are valid • the status data for slots 3 and 4 are not valid • slots 2, 5, and 7 are not configured
set the inhibit bit so that the processor will not attempt to establish a connection with the module or message	1. Move the cursor to the **Inhibit** field for that entry 2. Type a **1** 3. Press **[Enter]**

If you want to:	Do this:
clear the inhibit bit so that the processor will attempt to establish a connection with the module or message	**1.** Move the cursor to the **`Inhibit`** field for that entry **2.** Type a **`0`** **3.** Press **`[Enter]`**
set the reset bit so that the processor will set the output module or message's Run/Program command to Program mode	**1.** Move the cursor to the **`Reset`** field for that entry **2.** Type a **`1`** **3.** Press **`[Enter]`**
clear the reset bit so that the processor will set the output module or message's Run/Program command to the processor's mode	**1.** Move the cursor to the **`Reset`** field for that entry **2.** Type a **`0`** **3.** Press **`[Enter]`**
return to the ControlNet I/O Mapping (Monitor) screen	Press **`[Esc]`**

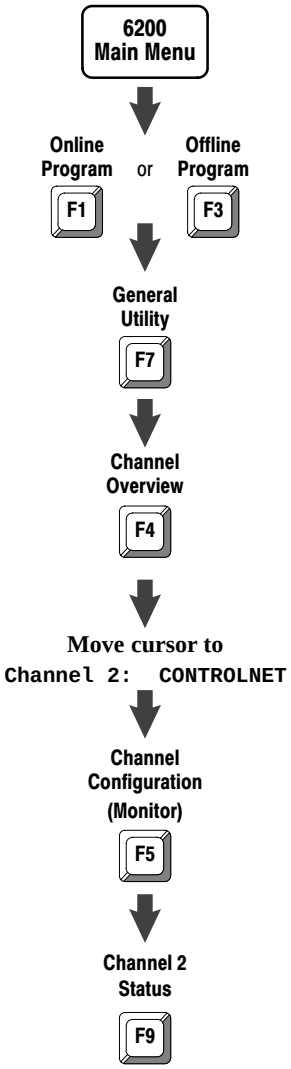
Using the ControlNet I/O Action (Monitor) Screen



Follow the steps on the left to go to the ControlNet I/O Action (Monitor) screen.

```
                          ControlNet – I/O Action                    MONITOR
                           Channel 2 Configuration                   NODE  1

Node  4 1794-ACN

   Module Type        Fault Action         Idle Action        Fault Action
Slot                                                          From Idle

 0 1794-Digital     Reset                Reset                Idle
 1 1794-IE8/A       Reset                Reset                Idle
 2 1794-OE4/A       Safe                 Reset                Idle
 3 1794-IE4XOE2/A   Safe                 Reset                Idle
 4 1794-Digital     Reset                Reset                Idle
 5 1794-Digital     Reset                Reset                Idle
 6 1794-Digital     Reset                Reset                Idle
 7 1794-Digital     Reset                Reset                Idle


Press a function key.
>
Rem Prog   Forces:None                                    5/40C File CN
         Map                                      Define           Edit
       Monitor                                    LclRack         Actions
         F2                                         F7              F9
```

If you want to:	Do this:
go to the ControlNet I/O Mapping (Monitor) screen	Press **[Esc]** or **[F2]—Map Monitor**
define the characteristics of the local chassis **Important:** This option is not available if you are programming online.	Press **[F7]—Define LclRack**
view a module's fault action—i.e., the action that it takes when it faults	Look at the module's field in the **Fault Action** column • **Reset**—changes all outputs to zero • **Hold Last**—maintains all current output values • **Safe**—changes all outputs to user-specified fail-safe values
view a module's idle action—i.e., the action that it takes when it becomes idle	Look at the module's field in the **Idle Action** column • **Reset**—changes all outputs to zero • **Hold Last**—maintains all current output values • **Safe**—changes all outputs to user-specified fail-safe values
view a module's fault action from idle —i.e., the action that it takes when it faults from idle	Look at the module's field in the **Fault Action From Idle** column • **Idle**—uses the idle action • **Fault**—uses the fault action
go to the ControlNet I/O Action (Edit) screen	Press **[F9]—Edit Actions**



Using the ControlNet Channel 2 Status Screen

Follow the steps on the left to go to the ControlNet Channel 2 Status screen.

```
                          ControlNet
                       Channel 2 Status
                                                          COUNTERS LOCKED
Frames                                                 media usage:     A Only
  transmitted good:        0  transmitted aborted:   0  channel A errors:     0
  received good:           0  received aborted:      0  channel B errors:   n/a
  total received:          0  received bad:          0  channel warnings:  none

Network Capacity
  update time overload:    0  blockage:             0

Moderator Node:            1
  mismatch events:         0  unheard occurrences:   0

Misc
  out of step events:      0  network silent:        0  noise detected:       0
  commands received:       0  collisions:            0

Press a function key.
>
Rem Prog   Forces:None                                      5/40C File CN
 Clear  Unlock                                                    Chan 2
Counter Counter                                                   Config
  F1      F2                                                        F9
```

If you want to:	Do this:
clear all the ControlNet diagnostic counters	Press **[F1]—Clear Counter**
toggle to lock all the counters on the screen (while they continue to run in the background); then toggle back to unlock the counters so that they are updated continuously	1. Press **[F2]—Lock Counter** 2. Press **[F2]—Unlock Counter**
go to the ControlNet Node Information (Monitor) screen	Press **[F9]—Chan 2 Config**
go to the Channel Overview screen	Press **[Esc]**

This status field:	Word; Bits:[1]	Displays:[2]
COUNTERS LOCKED		when the display of the counters stops changing—the counters continue to run in the background; current values are continuously updated when COUNTERS LOCKED is not displayed
media usage		the media redundancy characteristic for the ControlNet channel—A/B, A Only, or B Only
Frames		
transmitted good	6; 15-08 5; 07-00 5; 15-08	number of good frames transmitted
transmitted aborted	9; 07-00	number of frames that could not be transmitted completely and were aborted during transmission
received good	7; 07-00 7; 15-08 6; 07-00	number of good frames received on the active channel
received aborted	12; 07-00	number of frames received that were aborted during transmission on the active channel
received bad	8; 15-08	number of unusable frames received on the active channel
total received		number of frames—good and bad—received on the active channel
channel A errors	8; 07-00	number of frames received on channel A that were unusable independent of the active channel—channel selected for reception
channel B errors	9; 15-08	number of frames received on channel B that were unusable independent of the active channel—channel selected for reception
channel warnings	23; 07-06	any channel that is receiving a low level of unusable frames—i.e., frames containing data errors
Network Capacity		
update time overload	10; 07-00	number of times that a NUI passes with no opportunity to transmit
blockage	11; 07-00	number of times that a NUI does not contain enough room to allow the transmission of a particular frame
moderator node	15; 15-08	network address of the node that is transmitting the moderator frame—always the lowest active network address
mismatch events	16; 15-08	number of times a moderator frame was received with network parameters different from those in the receiving node
unheard occurrences	16; 07-00	number of times a node can receive a frame from a lower network address but cannot receive a moderator
Misc		
out of step events	10; 15-08	number of times any event prevents a frame from being transmitted in the NUI in which it should be transmitted
network silent	13; 15-08	number of times a node cannot hear any network activity for three consecutive NUIs
noise detected	14; 15-08	number of times that a start of frame could not be detected
commands received	17; 15-08	number of station commands received directly from the network that bypass the node's host processor
collisions	14; 07-00	number of times that a node prevents the transmission of a frame because it would cause a collision to occur

[1] In user-specified Diagnostics File
[2] All counters display only the status of the node being examined

Using the ControlNet WHO ACTIVE—Active Node Identification Screen

Important: Keep the following in mind:

- ControlNet WHO screens are available only when your programming device is communicating through a 1784-KTC card, 1784-KTC*x* card, or 1770-KFC interface on the ControlNet network.
- When you view the WHO screens while your ControlNet system is operating, you affect the performance of unscheduled I/O operations.

The ControlNet WHO ACTIVE—Active Node Identification screen displays the active nodes up to the number of maximum unscheduled nodes. Follow the steps on the left to go to the ControlNet WHO ACTIVE—Active Node Identification screen.

```
+-------- ControlNet WHO ACTIVE – Active Node Identification ------------------+
| 01 5/40C      CN                                                             |
| 02 1771-ACN                                                                  |
| 03 5/20C                                                                     |
| 04 1794-ACN                                                                  |
| 05                                                                           |
| 06                                                                           |
| 07                                                                           |
| 08                                                                           |
| 09                                                                           |
| 10                                                                           |
| 11                                                                           |
| 12                                                                           |
| 13                                                                           |
| 14                                                                           |
| 15                                                                           |
+--- ESC exits --[ WHO rate = 4 sec ]----[ Maximum Unscheduled Nodes = 15 ]----+

Press a function key, or page up or page down.

  Net Channel A Status: Cable Good        Net Channel B Status: Cable Inactive
Online   Node                  Channel Network                  Save     Who
Program  Diags                  Diags   Diags                  Config   Rate
  F1      F2                     F5      F6                     F9      F10
```

If you want to:	Press:
attach to the PLC-5 processor node of the highlighted entry	**[F1]—Online Program**
go to the ControlNet WHO ACTIVE—Active Node Status screen	**[F2]—Node Diags**
go to the ControlNet WHO ACTIVE—Channel Status screen	**[F5]—Channel Diags**
go to the ControlNet WHO ACTIVE—Network Status screen	**[F6]—Network Diags**
save the current ControlNet WHO configuration as the permanent ControlNet WHO configuration	**[F9]—Save Config**
enter a new ControlNet WHO rate	**[F10]—WHO Rate**
go to the ControlNet WHO screen	**[Esc]**

This field:	Displays:
Net Channel Status Line	the status of channel A and channel B • **`Cable Good`** = channel is usable • **`Cable WARN`** = channel is experiencing problems but still usable • **`Cable FAULTED`** = channel is not usable • **`Cable Inactive`** = channel unused (in non-redundant network)

Using the ControlNet WHO ACTIVE—Active Node Status Screen

Important: Keep the following in mind:

- ControlNet WHO screens are available only when your programming device is communicating through a 1784-KTC card, 1784-KTC*x* card, or 1770-KFC interface on the ControlNet network.
- When you view the WHO screens while your ControlNet system is operating, you affect the performance of unscheduled I/O operations.

Follow the steps on the left to go to the ControlNet WHO ACTIVE—Active Node Status screen.

```
+-- ControlNet WHO ACTIVE – Active Node Status ---------------------------------+
|                                                                               |
|Frames                                                media usage:     A Only|
| transmitted good:        0  transmitted aborted:  0   channel A errors:     0|
| received good:           0  received aborted:     0   channel B errors:     0|
| total received:          0  received bad:         0   channel warnings:  none|
|                                                                               |
|Network Capacity                                                               |
| update time overload:    0  blockage:             0                           |
|                                                                               |
|Moderator Node:           1                                                    |
| mismatch events:         0  unheard occurrences   0                           |
|                                                                               |
|Misc                                                                           |
| out of step events:      0  network silent:       0   noise detected:       0|
| commands received:       0  collisions:           0                          |
+- ESC exits ---[ WHO rate = 4 sec ]-------------------------------------------+

Press a function key.

Remote Program            PLC-5/40C Series C  Revision A         CNET Node 1
         Clear   Lock                                            Save     Who
       Counter Counter                                         Config    Rate
         F2      F3                                              F9      F10
```

If you want to:	Do this:
clear all the ControlNet diagnostic counters	Press **[F2]—Clear Counter**
toggle to lock all the counters on the screen (while they continue to run in the background); then toggle back to unlock the counters so that they are updated continuously	1. Press **[F3]—Lock Counter** 2. Press **[F3]—Unlock Counter**
save the current ControlNet WHO configuration as the permanent ControlNet WHO configuration	Press **[F9]—Save Config**
enter a new ControlNet WHO rate	Press **[F10]—WHO Rate**
go to the ControlNet WHO ACTIVE—Active Node Identification screen	Press **[Esc]**

For descriptions of the status fields on the ControlNet WHO ACTIVE—Active Node Status screen, see page 5-13.

Using the ControlNet WHO ACTIVE—Channel Status Screen

Important: Keep the following in mind:

- ControlNet WHO screens are available only when your programming device is communicating through a 1784-KTC card, 1784-KTC*x* card, or 1770-KFC interface on the ControlNet network.
- When you view the WHO screens while your ControlNet system is operating, you affect the performance of unscheduled I/O operations.

Follow the steps on the left to go to the ControlNet WHO ACTIVE—Channel Status screen.

```
+-- ControlNet WHO ACTIVE – Channel Status ------------------------------------+
| Node   Active  Channel A Channel B      Bad frame received from node number  |
|        Channel  Status    Status        most recent to least recent          |
|-------------------------------------------------------------------------------|
|  01       A     Good      Inactive                                           |
|  02       A     Good      Inactive                                           |
|  03       A     Good      Inactive                                           |
|  04       A     Good      Inactive                                           |
|  05                                                                          |
|  06                                                                          |
|  07                                                                          |
|  08                                                                          |
|  09                                                                          |
|  10                                                                          |
|  11                                                                          |
|  12                                                                          |
+--- ESC exits --[ WHO rate = 4 sec ]----[ Maximum Unscheduled Nodes = 12 ]----+

Press a function key, or page up or page down.

  Net Channel A Status: Cable Good        Net Channel B Status: Cable Inactive
                                       Network                  Save     Who
                                        Diags                  Config   Rate
                                         F6                      F9      F10
```

If you want to:	Press:
go to the ControlNet WHO ACTIVE—Network Status screen	**[F6]—Network Diags**
save the current ControlNet WHO configuration as the permanent ControlNet WHO configuration	**[F9]—Save Config**
enter a new ControlNet WHO update rate	**[F10]—WHO Rate**
go to the ControlNet WHO ACTIVE—Active Node Identification screen	**[Esc]**

This field:	Displays:
Node	a device's network address
Active Channel	the channel that the node is using
Channel A Status	the status of the channel A for the specified node • **Good** = channel A is receiving no unusable frames • **WARN** = channel A is receiving a low level of unusable frames • **FAULTED** = channel A is receiving a high level of unusable frames; it is not usable • **Inactive** = channel A is not currently active

Appendix A

Processor Specifications

Heat Dissipation	54 BTU/hr
Environmental Conditions	Operating Temperature: 0 to 60° C (32-140° F) Storage Temperature: -40 to 85° C (-40 to 185° F) Relative Humidity: 5 to 95% (without condensation)
Shock and Vibration	**Vibration Testing (operating and non-operating):** 1 g @ 10 to 500 Hz 0.012 inches peak-to-peak displacement **Shock:** Operating . . . . . 30 g peak acceleration for 11±1 ms duration Non-operating . . . . 50 g peak acceleration for 11±1 ms duration
Time-of-Day Clock/Calendar	Maximum Variations at 60° C: ± 5 min per month Typical Variations at 20° C: ± 20 s per month Timing Accuracy: 1 program scan
Battery	1770-XYC
Memory Modules	• 1785-ME16 • 1785-ME32 • 1785-ME64 • 1785-M100
I/O Modules	Bulletin 1771 I/O, 1794 I/O, 1746 I/O, and 1791 I/O including 8-, 16-, 32-pt, and intelligent modules
Hardware Addressing	2-slot • Any mix of 8-pt modules • 16-pt modules must be I/O pairs • No 32-pt modules 1-slot • Any mix of 8- or 16-pt modules • 32-pt modules must be I/O pairs 1/2-slot—Any mix of 8-,16-, or 32-pt modules
Communication	• Serial • DH+ • DH using 1785-KA • Remote I/O • ControlNet
Location	1771-A1B, -A2B, A3B, -A3B1, -A4B, -AM1, -AM2 chassis; left-most slot
Weight	PLC-5/40C: 3 lbs, 2 oz (1.42 kg) PLC-5/20C: 3 lbs, 3 oz (1.45 kg)
Keying	• Between 40 and 42 • Between 54 and 56
Agency Certification (When product is marked)	• CSA Class I, Division 2, Groups A, B, C, D • UL listed

		PLC-5/20C	PLC-5/40C
Maximum User Memory Words		16K	48K[1]
Maximum Total I/O	**Any Mix**	512	2048
	Complimentary	512 in and 512 out	2048 in and 2048 out
Program Scan Time		0.5 ms per K word (bit logic) 2 ms per K word (typical)	
ControlNet I/O[2]	**Maximum Non-discrete I/O Data-Transfer Data-Table Size**	1000 words in and 1000 words out	
	Transmission Rate	5M bit/s	
	Network Update Time (NUT)	2-100 ms (user selectable)	
	Number of ControlNet Ports	1	
	Number of Redundant Media ControlNet Ports	1	
	Maximum Number of Nodes per Link without a Repeater	48—with 250 m (approx. 820 ft) cable length	
	Maximum Number of Nodes per Link with Repeaters	107	
	Maximum Link Cable Length without a Repeater	1,000 m (approximately 3,280 ft)—with 2 nodes 500 m (approximately 1,640 ft)—with 32 nodes 250 m (approximately 820 ft)—with 48 nodes	
	Maximum Link Cable Length with Repeaters	6,000 m (approximately 19,680 ft)—with 2 nodes 3,000 m (approximately 9,840 ft)—typical	
	Maximum Number of Repeaters in Series per Link	5	
	Maximum Number of Segments in Series per Link	6	
Non-ControlNet Remote I/O	**Transmission Rate**	57.6K bit/s 115.2K bit/s 230.4K bit/s	
	I/O Scan Time (Typical)	10 ms per rack @ 57.6K bit/s 7 ms per rack @ 115.2K bit/s 3 ms per rack @ 230K bit/s	
	Maximum Number of Remote I/O Racks	4	16
	Maximum Number of Remote I/O Devices	12	60
	Number of Ports Configurable for DH+ or Remote I/O (Adapter or Scanner)	1	2
	Number of Dedicated DH+ Ports	1	0
Number of Serial Ports		1	
Number of Coprocessor Ports		1	
Maximum Number of MCPs		16	
Backplane Current Load	**Maximum**	3.0 A	
	Typical	2.7 A	

[1] The PLC-5/40C processor has a limit of 32K words per data-table file.

[2] See the ControlNet Cable System Planning and Installation Manual, publication 1786-6.2.1, for more information.

Appendix **B**

Processor Status File

Processor status data is stored in data-file 2.

S:0-S:2

This word of the status file:	Stores:
S:0	Arithmetic flags • bit 0 = carry • bit 1 = overflow • bit 2 = zero • bit 3 = sign
S:1	Processor status and flags Bit — Description 0 — RAM checksum is invalid at power-up 1 — processor in Run mode 2 — processor in Test mode 3 — processor in Program mode 4 — processor burning EEPROM 5 — enabled download operation 6 — enabled test edit mode 7 — mode select switch in Remote position 8 — forces enabled 9 — forces present 10 — processor successfully burned EEPROM 11 — performing online programming 12 — processor in Debug mode 13 — user program checksum done 14 — last scan of ladder or SFC step 15 — processor started fist program scan or the first scan of the next step in an SFC
S:2	Switch setting information • bits 0–7 DH+ station number • bit 11-12 are set based on the I/O chassis backplane switches bit 12 — bit 11 = I/O chassis addressing 0 — 0 — illegal 1 — 0 — 1/2-slot 0 — 1 — 1-slot 1 — 1 — 2-slot • bit 13: 1 = load from EEPROM • bit 14: 1 = RAM backup not configured • bit 15: 1 = memory unprotected

S:3-10

This word of the status file:	Stores:
S:3 to S:6	Active Node table for channel 1A Word Bits DH+ Station # 3 0-15 00-17 4 0-15 20-37 5 0-15 40-57 6 0-15 60-77
S:7	Global status bits: • low 8 bits—rack fault bits for racks 0-7 • high 8 bits—rack queue-full bits for racks 0-7
S:8	Last program scan (in ms)
S:9	Maximum program scan (in ms)
S:10	Minor fault (word 1) Bit Description 0 battery is missing or low (replace in 1-2 days) 1 DH+ table has changed (active node table) 2 STI delay too short, interrupt program overlap 3 EEPROM memory transfer at power-up 4 edits prevent SFC continuing 5 invalid I/O status file 6 memory–cartridge battery low 7 no more command blocks exist 8 not enough memory on the memory module to upload the program from the processor 9 no MCP is configured to Run 10 MCP not allowed 11 PII word number not in local rack 12 PII overlap 13 no command blocks exist to get PII 14 arithmetic overflow 15 SFC action overlap

S:11-S:12

This word of the status file:	Stores:
S:11	Major fault Bit — Description 0 — corrupted program file (codes 10-19) 1 — corrupted address in ladder file (codes 10-29) 2 — programming error (codes 30-49) 3 — SFC fault (codes 71-79) 4 — error while assembling program (code 70) 5 — start-up protection fault 6 — peripheral device fault 7 — jumped to fault routine (codes 0-9) 8 — watchdog faulted 9 — system configured wrong (codes 80-89) 10 — recoverable hardware error 11 — MCP does not exist or is not ladder or SFC file 12 — PII does not exist or is not ladder 13 — STI does not exist or is not ladder 14 — fault routine does not exist or is not ladder 15 — fault routine file is not a ladder file
S:12	Fault codes Code — Description 0-9 — user-defined 10 — failed data table check 11 — bad user program checksum 12 — bad integer operand type 13 — bad mixed mode operand type 14 — not enough operands for instruction 15 — too many operands for instruction 16 — bad instruction found 17 — no expression end 18 — missing end of edit zone 19 — download aborted 20 — indirect address out of range (high) 21 — indirect address out of range (low) 22 — attempt to access undefined file 23 — file number less than 0 or greater than number of defined files; or, indirect reference to file 0, 1, 2; or bad file number 24 — indirect reference to wrong file type 30 — subroutine jump nesting level exceeded 31 — too few subroutine parameters 32 — jump to non-ladder file 33 — CAR routine not 68000 code 34 — bad timer parameters entered 35 — bad PID delta time entered 36 — PID setpoint out of range 37 — invalid I/O specified in an immediate I/O instruction 38 — invalid use of return instruction 39 — FOR loop missing NXT 40 — control file too small 41 — NXT instruction with no FOR 42 — jump target does not exist 43 — file is not an SFC 44 — error using SFR 45 — invalid channel number entered 46 — IDI or IDO instruction length operand too long (> 64 words) 47-69 — reserved

S:12-S:16

This word of the status file:	Stores:
S:12 (continued)	Fault codes Code — Description 70 — duplicate labels 71 — SFC subchart is already executing 72 — tried to stop an SFC that is not running 73 — maximum number of SFC subcharts exceeded 74 — SFC file error 75 — SFC contains too many active steps 77 — SFC references a step, transition, subchart, or SC file that is missing, empty, or too small 78 — SFC could not continue after power loss 79 — error in downloading an SFC to a processor that cannot run SFCs or this specific PLC processor does not support this enhanced SFC 80 — I/O configuration error 81 — illegal setting of I/O chassis backplane switch 82 — illegal cartridge type 83 — user watchdog fault 84 — error in user-configured adapter mode block transfers 85 — bad cartridge 86 — cartridge incompatible with host 87 — rack overlap (includes any adapter channel) 88 — scanner channels are overloading the remote I/O buffer; too much data for the processor to process 90 — coprocessor extensive memory test failed 91 — coprocessor undefined message type 92 — coprocessor illegal pool index 93 — coprocessor illegal maximum pool size 94 — coprocessor illegal ASCII message 95 — coprocessor reported fault 96 — coprocessor present signal lost 97 — coprocessor illegal minimum pool size 98 — coprocessor first/last 16 bytes RAM test failed 99 — coprocessor to processor data transfer faulted 100 — processor to coprocessor transfer failed 101 — coprocessor end of scan transfer failed 102 — file number specified for raw data transfer through the coprocessor is an illegal value 103 — element number specified for raw data transfer through the coprocessor is an illegal value 104 — size of the transfer requested through the coprocessor is an illegal size 105 — offset into the raw transfer segment of the coprocessor is an illegal value 106 — coprocessor transfer protection violation 200 — ControlNet output transfer missed 201 — ControlNet input data missed 202 — ControlNet diagnostic data missed 203 — ControlNet scheduled transmit data overflow 204 — ControlNet configuration too complex for the PLC-5 processor
S:13	Program file where fault occurred
S:14	Rung number where fault occurred
S:15	VME status file
S:16	I/O Status File

S:17-S:27

This word of the status file:	Stores:
S:17	Minor fault (word 2) Bit — Description 0 — BT queue full to remote I/O 1 — queue full—channel 1A 2 — queue full—channel 1B 3 — queue full—channel 2A 4 — queue full—channel 2B 5 — no modem on serial port 6 — remote I/O rack in local rack table; or, remote I/O rack is greater than the image size 7 — plug firmware revision does not match processor firmware revision 8 — ASCII instruction error 9 — duplicate network address 10 — DF1 master poll list error 11 — protected-processor data-table element violation 12 — protected-processor file violation 13 — using all 32 ControlNet MSGs 14 — using all 32 ControlNet 1771 READ and/or 1771 WRITE CIOs 15 — using all 8 ControlNet Flex I/O CIOs
S:18	Processor clock year
S:19	Processor clock month
S:20	Processor clock day
S:21	Processor clock hour
S:22	Processor clock minute
S:23	Processor clock second
S:24	Indexed addressing offset
S:26	User control bits Bit — Description 0 — Restart/continuous SFC: when reset, processor restarts at first step in SFC. When set, processor continues with active step after power loss or change to Run 1 — Start-up protection after power loss: when reset, no protection. When set, processor executes fault routine at power-up (sets word 11, bit 5). 2 — Define the address of the local rack: when reset, local rack address is 0. When set, local rack address is 1. 3 — Set complementary I/O: when reset, complementary I/O is not enabled. When set, complementary I/O is enabled. 4 — Local block transfer compatibility bit: when reset, normal operation. When set, eliminates frequent checksum errors to certain BT modules. 5 — When set (1), delay adapter channel response by 1 s for compatibility with PLC-3 scanners. When reset (0), operate in normal response time.
S:27	Rack control bits: • low 8 bits—I/O rack inhibit bits for racks 0-7 • high 8 bits—I/O rack reset bits for racks 0-7

S:28-S:61

This word of the status file:	Stores:
S:28	Program watchdog setpoint
S:29	Fault routine file
S:30	STI setpoint
S:31	STI file number
S:32	Global status bits: • low 8 bits—rack fault bits for racks 10-17 (octal) • high 8 bits—rack queue-full bits for racks 10-17
S:33	Rack control bits: • low 8 bits—I/O rack inhibit bits for racks 10-17 • high 8 bits—I/O rack reset bits for racks 10-17
S:34	Global status bits: • low 8 bits—rack fault bits for racks 20-27 (octal) • high 8 bits—rack queue-full bits for racks 20-27
S:35	Rack control bits: • low 8 bits—I/O rack inhibit bits for racks 20-27 • high 8 bits—I/O rack reset bits for racks 20-27
S:46	PII program file number
S:47	PII module group
S:48	PII bit mask
S:49	PII compare value
S:50	PII down count
S:51	PII changed bit
S:52	PII events since last interrupt
S:53	STI scan time (in ms)
S:54	STI maximum scan time (in ms)
S:55	PII last scan time (in ms)
S:56	PII maximum scan time (in ms)
S:57	User program checksum
S:59	Extended-local I/O channel discrete transfer scan (in ms)
S:60	Extended-local I/O channel discrete maximum scan (in ms)
S:61	Extended-local I/O channel block-transfer scan (in ms)

S:62-S:127

This word of the status file:	Stores:
S:62	Extended-I/O channel maximum block-transfer scan (in ms)
S:63	Protected-processor data-table protection-file number
S:64	Number of remote block-transfer command blocks being used by channel-pair 1A/1B
S:76	Number of slots in processor-resident local rack 0 Illegal 1 4 slots 2 12 slots 3 8 slots 4 16 slots
S:77	Communication time slice for communication housekeeping functions (in ms)
S:78	MCP I/O update disable bits Bit 0 for MCP A Bit 1 for MCP B etc.
S:79	MCP inhibit bits Bit 0 for MCP A Bit 1 for MCP B etc.
S:80-S:127	MCP file number MCP scan time (in ms) MCP max scan time (in ms) The above sequence applies to each MCP; therefore, each MCP has 3 status words. For example, word 80: file number for MCP A word 81: scan time for MCP A word 82: maximum scan time for MCP A word 83: file number for MCP B word 84: scan time for MCP B etc.

Appendix C

ControlNet Instruction Set

ControlNet I/O Transfer Instruction

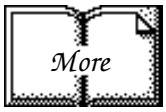
Instruction		Description
CIO CNET I/O TRANSFER Control block CT21:50	ControlNet I/O Transfer CT	If the input conditions go from false to true, the data is transferred according to the instruction parameters you set when you enter the ControlNet I/O transfer instruction. The Control Block (CT21:50) contains status and instruction parameters.
	Status Bits TO—Time-Out Bit EW—Enabled-Waiting Bit CO—Continuous Bit ER—Error Bit DN—Done Bit ST—Start Bit EN—Enable Bit	You cannot use N (integer) control blocks on the ControlNet network. For continuous CIOs, condition the rung to be true for only one scan.

Message Instructions on a ControlNet Network

Instruction		Description
MSG SEND/RECEIVE MESSAGE Control block MG10:10	Message MSG	If the input conditions go from false to true, the data is transferred according to the instruction parameters you set when you enter the message instruction. The Control Block (MG10:10) contains status and instruction parameters.
	Status Bits TO—Time-Out Bit EW—Enabled-Waiting Bit CO—Continuous Bit ER—Error Bit DN—Done Bit ST—Start Bit EN—Enable Bit	You cannot use N (integer) control blocks on the ControlNet network. For continuous MSGs, condition the rung to be true for only one scan.

Immediate Data I/O Instructions

Instruction		Description
IDI IMMEDIATE DATA INPUT Data file offset 232 Length 10 Destination N11:232	Immediate Data Input IDI	If the input conditions are true, an immediate data input is initiated that updates the destination file from the private buffers before the next normal input-image update. The Data file offset (232) is where the data is stored. The Length (10) identifies the number of words in the transfer—it can be an immediate value ranging from 1 to 64 or a logical address that specifies the number of words to be transferred. The Destination (N11:232) is the destination of the words to be transferred. The Destination should be the matching data-table address in the DIF except when you use the instruction to ensure data-block integrity in the case of Selectable Timed Interrupts (STIs). See page 4-7.
IDO IMMEDIATE DATA OUTPUT Data file offset 175 Length 24 Source N12:175	Immediate Data Output IDO	If the input conditions are true, an immediate data output is initiated that updates the private memory output buffers from the source file before the next normal output-image update. The Data file offset (175) is the offset into the buffer where the data is stored. The Length (24) identifies the number of words in the transfer—it can be an immediate value ranging from 1 to 64 or a logical address that specifies the number of words to be transferred. The Source (N12:175) is the source of the words to be transferred. The Source should be the matching data-table address in the DOF except when you use the instruction to ensure data-block integrity in the case of Selectable Timed Interrupts (STIs). See page 4-7.



For detailed information on the instruction set for programming PLC-5 processors, see the Enhanced and Ethernet PLC-5 Programmable Controllers User Manual, publication 1785-6.5.12, and the PLC-5 Programming Software Instruction Set Reference, publication 6200-6.4.11.

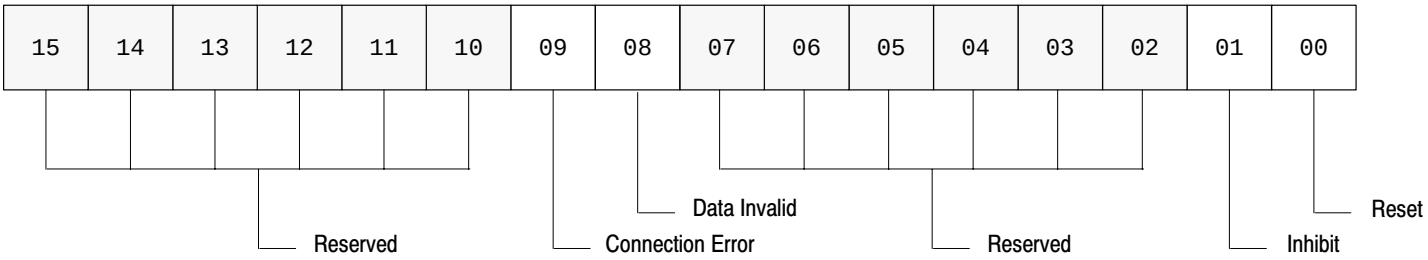
Appendix **D**

ControlNet I/O Map-Entry Status Words and Error Messages

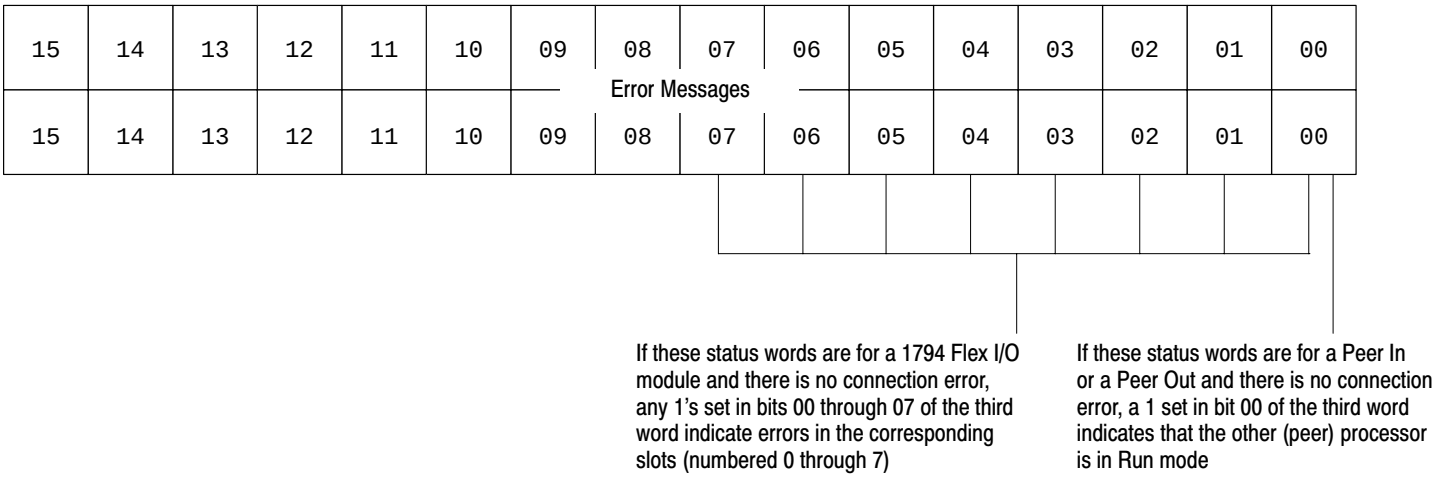
I/O Map-Entry Status Words

The ControlNet status file is an integer data-table file that you specify and configure with the I/O map for scheduled-I/O usage. It containing status information about all of the ControlNet network's scheduled I/O connections. Each I/O map-table entry has a status-file offset field pointing to three status words associated with the connection.

First Word



Second and Third Words


15 14 13 12 11 10 09 08 07 06 05 04 03 02 01 00
Error Messages
15 14 13 12 11 10 09 08 07 06 05 04 03 02 01 00
If these status words are for a 1794 Flex I/O module and there is no connection error, any 1's set in bits 00 through 07 of the third word indicate errors in the corresponding slots (numbered 0 through 7)
If these status words are for a Peer In or a Peer Out and there is no connection error, a 1 set in bit 00 of the third word indicates that the other (peer) processor is in Run mode

Error Messages

The following is a list of ControlNet error codes, messages, possible causes, and possible corrective actions:

Decimal Code	Hex. Code	Error Message	Explanation / Possible Cause(s)	Possible Corrective Action(s)
Various	Various	**CONFIGURATION DATA CORRUPTED**	More than one configured and/or programmed data transfer is trying to use the same location in the data table	Re–configure map entryoverlapping map-table locations or Re–enter overlapping ladder instructions
2	0x0002	**SCHED BANDWIDTH NOT AVAILABLE**	There are too many words scheduled for transmission	Reduce the number of words scheduled for transmission
			The network update time (NUT) is too small	Increase the network update time (NUT)
			The target node is not configured	Correctly configure the target node as an active node on the ControlNet network and save your ControlNet configuration
18	0x0012	**TARGET NODE NOT RESPONDING**	The ControlNet cable to the target node is broken and/or disconnected	Fix and/or reconnect the ControlNet cable to the target node
			No power is being received by the target node	Supply power to the target node
			The target node is offline	Correctly configure the target node as an active node on the ControlNet network and save your ControlNet configuration
20	0x0014	**DEST SLOT/MSG NOT PRESENT**	The slot number that you entered for an adapter is not in the valid range	Correct the map-table entry
			The number that you entered for an peer-to-peer message is not in the valid range	
			The peer-to-peer message map-table entry in the target node is inhibited	Clear the inhibit bit in the map-table entry of the target node
256	0x0100	**CONNECTION IN USE**	The connection that the originating node is trying to use is already in use	No action required—connection can be re-established after the target node times out the old connection
260	0x0104	**NODE TYPE MISMATCH**	You entered a node type in the map table that does not match the target node	Correct the map-table entry or Replace the target node with the node type entered in the map table
262	0x0106	**CONNECTION USED BY OTHER NODE**	The originating node attempted to open a connection that is already being used by another node	Delete or inhibit any other node's connection so that the preferred node can open the connection
263	0x0107	**CONNECTION ALREADY CLOSED**	The connection that the originating node is trying to close is already closed	No action required
265	0x0109	**INVALID CONNECTION SIZE**	The originating node attempted to open a connection with a larger size than the target node can support	Reduce the size that is entered in the map table or Use a rack with a greater number of slots or Use a rack with higher density
272	0x0110	**NODE NOT CONFIGURED**	The target node is offline	Correctly configure the target node as an active node on the ControlNet network and save your ControlNet configuration
			The target node is not configured	

Decimal Code	Hex. Code	Error Message	Explanation / Possible Cause(s)	Possible Corrective Action(s)
273	0x0111	**EXP NET PCKT TIME INVALID**	The target node cannot produce the data at or faster than the expected net packet time entered in the map table	Increase the expected net packet time entered in the map table
511	0x01FF	**INVALID WHEN NODE IS IDLE** The originating node attempted to open a data-transfer connection before a node connection was opened	The ControlNet cable to the target node is broken and/or disconnected	Fix and/or reconnect the ControlNet cable to the target node
			No power is being received by the target node	Supply power to the target node
			The target node is offline	Correctly configure the target node as an active node on the ControlNet network and save your ControlNet configuration
			The target adapter is in Processor Restart Lockout	Press the reset button on the target adapter
513	0x0201	**CONNECTION ALREADY CLOSED**	The connection that the originating node is trying to close has not been opened by the target node	No action required
515	0x0203	**CONNECTION TIMED OUT**	The ControlNet cable to the target node has become broken and/or disconnected	Fix and/or reconnect the ControlNet cable to the target node
			Power is no longer being received by the target node	Supply power to the target node
65281	0xFF01	**CONNECTION REJECTED**	The ControlNet cable to the target node is broken and/or disconnected	Fix and/or reconnect the ControlNet cable to the target node
			No power is being received by the target node	Supply power to the target node
			The target node is offline	Correctly configure the target node as an active node on the ControlNet network and save your ControlNet configuration
65294	0xFF0E	**ATTRIBUTE CANNOT BE SET**	Your program attempted to set an attribute that cannot be set for a specific module—e.g., a CIO instruction tried to send safe-state data to a flex module that does not support safe-state data	Change your program so that it does not attempt to set the attribute
				Insert a module that can have this attribute set
65299	0xFF13	**NOT ENOUGH DATA**	The transfer length is zero	Increase the length of the transfer
			The processor data table is too small	Increase the size of the data table to accommodate the transfer length
65301	0xFF15	**TOO MUCH DATA**	The transfer length is too large	Decrease the length of the transfer
65522	0xFFF2	**CONFIG FROM MAP ENTRY FAILED**	The ControlNet cable to the target node is broken and/or disconnected	Fix and/or reconnect the ControlNet cable to the target node
			No power is being received by the target node	Supply power to the target node
			The node or slot contains the wrong module type	Insert the proper module in the correct slot of the target node
			An incorrect module type was entered in the map table	Enter the correct module type in the map-table entry
65523	0xFFF3	**CONTROLNET TRANSFER QUEUE FULL**	The immediate CIO transfer could not be executed because the queue is full	Keep the number of active 1771 READ and/or 1771 WRITE CIOs at or under the maximum of 32

Decimal Code	Hex. Code	Error Message	Explanation / Possible Cause(s)	Possible Corrective Action(s)
65527	0xFFF7	MODULE TIMED OUT	The node or slot contains the wrong module type	Insert the proper module in the correct slot of the target node
			An incorrect module type was entered in the map table	Enter the correct module type in the map-table entry
65529	0xFFF9	COMM ERROR CAUSED LOSS OF DATA	A communication error between the module and adapter caused data to be lost	Make sure that the proper module is properly seated in the correct slot of the target node
				Make sure that the correct module type is entered in the map-table entry
65530	0xFFFA	MODULE DECLARED INVALID LENGTH	The node or slot contains the wrong module type	Insert the proper module in the correct slot of the target node
			An incorrect module type was entered in the map table	Enter the correct module type in the map-table entry
65531	0xFFFB	READ DATA INVALID	The node or slot contains the wrong module type	Insert the proper module in the correct slot of the target node
			An incorrect module type was entered in the map table	Enter the correct module type in the map-table entry
65532	0xFFFC	WRITE DATA INVALID	The node or slot contains the wrong module type	Insert the proper module in the correct slot of the target node
			An incorrect module type was entered in the map table	Enter the correct module type in the map-table entry
65533	0xFFFD	DATA TABLE TOO SMALL	The processor data table is too small	Increase the size of the data table to accommodate the transfer length

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Rockwell Automation

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Allen-Bradley Headquarters, 1201 South Second Street, Milwaukee, WI 53204 USA, Tel: (1) 414 382-2000 Fax: (1) 414 382-4444

Publication 1785-6.5.14—September 1995

PN 955116-44

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